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The Impact of State Characteristics on College Graduation Rates at Land-Grant Institutions

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of the requirements for the degree of
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ABSTRACT

As our nation's economy has become increasingly knowledge-based, an educated citizenry is paramount to maintaining a competitive edge in a global marketplace. Thus, college participation and completion have emerged as the gateway to survival and growth for individuals, states, and the nation, making college completion rates a top priority. Stakeholders have begun to equate graduation rates with institutional quality and performance and often use such data to make judgments, create policies, and allocate funding. However, graduation rates are not fully understood and numerous scholars urge caution when interpreting and utilizing single outcome measures. The purpose of this cross-sectional ecological study was to analyze the relationship between selected state characteristics and college completion rates at land-grant institutions and use those findings to create a graduation rate prediction model, inclusive of student, institutional, and state characteristics, that is more accurate than traditional prediction models comprised solely of student and institutional characteristics. Results of correlation and regression analyses indicated that the addition of state variables to a regression model increased the accuracy of predicted graduation rates. Specifically, the size of the traditional college-age population, higher education appropriations, and the ratio of two- to four-year enrollment were found to be significant state predictors and explained an additional 9.3% of the variance in graduation rates at land-grant institutions. The landscape of higher education does appear to be ecological in nature as a wide range of student, institutional, and state characteristics provide a better understanding of educational success. These findings support recommendations for improved interpretation, evaluation, and prediction of graduation rates as well as planning for higher education in order to turn state and national educational attainment goals into reality.

This dissertation is approved for recommendation
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DEDICATION

This dissertation is dedicated to my family. Without their love and support, I would have never finished the academic journey of a lifetime. My mother, Diana, deserves accolades for her unwavering willingness to help ensure I was successful in the program, from spending time with her grandchildren to running personal errands. Most importantly, during my young, formative years, she was a constant advocate of a college education.

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CHAPTER ONE

INTRODUCTION

As our nation's economy has become increasingly knowledge-based, an educated citizenry is paramount to maintaining a competitive edge in a global marketplace. Thus, college participation and completion have emerged as the gateway to survival and growth for individuals, states, and the nation as a whole (Lumina Foundation for Education, 2010; Schneider & Yin, 2011). Despite increased enrollment, data continue to illustrate stagnant trends in degree attainment in the United States when compared internationally, raising questions and concerns from higher education stakeholders about the future of the national workforce and economy. The increase in the proportion of high school graduates attending college over the last thirty years has not been met with a commensurate increase in the proportion of the entering college cohort that finishes college (Bound et.al, 2010). Consequently, during the last decade, the United States has fallen from leader to 12th place in the ratio of people with a bachelor's degree (Lewis, 2010). Basically, the U.S. is not keeping pace with the educational growth in competing countries. Table 1 illustrates the average annual growth in tertiary education attainment among the Organisation for Economic Cooperation and Development (OECD) nations between 2000 and 2010.

According to the most recent data available for the United States, of all first-time, full-time students entering four-year institutions in 2004, only about 58% graduated within six years (Aud et.al, 2012). This means 42% of students who started college did not complete a degree, resulting in lost potential for contribution to an increasingly knowledge-based workforce as well as national economic growth. Moreover, graduation rates at less-selective institutions often

hover around 25% or less (Carey & Dillon, 2011). The United States appears, to some degree, to be slowly losing its competitive edge in international college education.

Table 1
Tertiary Education Attainment Growth, 25-64 Year Old Population, 2000-2010[1]

Country	Average Annual Growth (%)	Country	Average Annual Growth (%)
Australia	3.2	Luxembourg	6.9
Austria	0.2	Mexico	1.7
Belgium	2.6	Netherlands	3.3
Canada	2.4	New Zealand	3.5
Czech Republic	4.3	Norway	2.8
Denmark	2.4	Poland	7.2
Finland	1.8	Portugal	5.7
France	2.8	Slovak Republic	5.3
Germany	1.3	Spain	3.1
Hungary	3.7	Sweden	3.3
Iceland	3.4	Switzerland	3.8
Ireland	7.3	Turkey	4.6
Italy	4.7	United Kingdom	4.0
Japan	2.9	**United States**	**1.3**
Korea	5.2		

[1]OECD, Education at a Glance, 2012

Not completing a degree has extraordinary consequences for the individual as well as society. Students who drop out of college experience a multitude of economic and social disadvantages. Lifetime earnings of those with no college degree are about $800,000 less than their college-educated counterparts (Carnevale et al., 2011). Unemployment rates for those with some or no college are twice that of bachelor's degree holders (Schneider & Yin, 2011). Dropouts who borrow money for college and fail to complete their degree are further challenged by fewer opportunities for employment and lower wages. Student loan debt is at an all-time

high, and students who do not complete a degree often endure years of financial hardship as a consequence (Carey & Dillon, 2011). In fact, college dropouts are four times more likely to default on their student loans than those who complete college (Nguyen, 2012).

Failure to achieve educational goals can also have long-lasting implications for mental and physical health and well-being. According to findings of multiple studies, one's level of education is directly associated with health; higher educational levels indicate better health status (Cutler & Lleras-Muney, 2006; Egerter et al., 2009). Research suggests three primary reasons for positive influence of education on health: 1) better employment and income, 2) knowledge and practice of healthier behaviors, and 3) social and psychological factors including a sense of control, social standing, and social support (Cutler & Lleras-Muney, 2006; Egerter et al., 2009). Unfortunately, the gap in health status between people who are well-educated and those who are less-educated has grown in recent decades (Freudenberg & Ruglis, 2007).

When citizens fail to access or attain the education necessary to support prosperity and wellness, the prosperity and wellness of the nation as a whole is jeopardized. Evidence suggests that living in a society with wide disparities in health, wealth, and education is worse for all of society's members (Bowen et al., 2009). Insufficient numbers of educated professionals necessary to meet the demands of an increasingly knowledge-based workforce has staggering economic implications. According to a recent report by McKinsey & Company, the cumulative achievement gap between the United States and better performing countries, between black and Latino student performance and white student achievement, between low-income students and their more affluent counterparts, and between low-performing states and the rest resembles a permanent recession, with the loss of GDP estimated to be about 30% (McKinsey & Company, 2009). As a result of lost domestic gross product and less than optimal workforce productivity,

federal and state income tax revenue continues to decline (Schneider & Yin, 2011). Moreover, individuals without a college degree are five time more likely to receive some form of public benefits or cash assistance grants and rely on worker's compensation or unemployment insurance (Hoffman & Reindl, 2011). A recent report by the American Institutes for Research (AIR), indicated that states spend more than $1.3 billion per year in aid and subsidies on students who drop out during their first year of college, and the federal government spends an additional $300 million (Schneider, 2010). The cumulative, long-term economic effect of an under-educated citizenry provides much of the impetus for the national call to action.

The cost associated with flat college graduation rates and the critical need to educate more Americans has not gone unnoticed. In his first address to a joint session of Congress in February 2009, President Obama set an ambitious goal of having the highest proportion of college graduates in the world by the year 2020. The National Governor's Association (NGA) joined the campaign with an initiative called "Complete to Compete" that has become part of what has become known as the "college completion agenda," a national effort aimed at increasing the number of college enrollees who complete their degree programs (Schneider & Yin, 2011; Wakelyn, 2009).

This charge from the President, accompanied by overwhelming support from state governors, has prompted a growing national movement focused on increasing student success and degree attainment (Russell, 2011). A substantial number of college completion initiatives, developed and supported by foundations, private businesses, higher education systems and institutions, and states have emerged (Carey, 2004; Lewis, 2010; Lumina Foundation for Education, 2010; Russell, 2011; Wakelyn, 2009). Major foundations such as the Bill and Melinda Gates Foundation, the Lumina Foundation for Education, the Ford Foundation, and the

Kresge Foundation have played a significant role in shaping as well as funding the national agenda (Russell, 2011).

The growing concern over stagnant graduation rates and accompanied surge in strategic completion initiatives has contributed to the rising demand for accountability. In large part, public colleges and universities are primary targets of increased pressure and scrutiny (Bastedo & Bowman, 2011; DeAngelo et.al, 2011; Leveille, 2006) as they bear the largest responsibility for achieving national completion goals and possess the greatest capacity to do so (Bowen et al., 2009; SREB, 2010). Approximately two-thirds of all full-time students pursuing bachelor's degrees at four-year colleges and universities attend public institutions. Public universities are, of course, subsidized by the states in which they are located, charge lower tuition to in-state than out-of-state students, and typically enroll undergraduate students who are residents of the state. Furthermore, part of the guiding mission of public institutions is the advancement of its citizenry (Bowen, et al., 2009). Increasingly, both internal and external stakeholders of higher education equate graduation rates with institutional quality and performance (Astin, 2005; Bowman & Bastedo, 2009; Leveille, 2006). As a result, college graduation rates often exert significant influence on stakeholder perceptions and behaviors. Students, institutions, policymakers, and others utilize college graduation rates in data-driven decision-making processes. Student choice, college rankings, state policies, federal agendas, and even the prosperity of an institution are driven, in part, by the number of students an institution graduates during a given time period (Bailey, 2006; Burke & Modarresi, 2000; Bowman & Bastedo, 2009; Cook & Pullaro, 2010; Hearn & Holdsworth, 2002; Hossler, 2000; Kelly & Schneider, 2011; Zusman, 2005).

While graduation rates are a valid output measure, they are not always interpreted in the context of appropriate input and process factors. Incomplete research and knowledge of all

possible input and process factors that contribute to college completion make it challenging to explain, predict, and effectively utilize college graduation rates. Characteristics that a student brings to an institution as well as characteristics of the institution itself exert a profound impact on the likelihood of college completion (Adelman, 1999; Astin, 2005; Attewell et al., 2011; Bound et al., 2010; Goenner & Snaith, 2004; Horn; 2006; Hosch, 2008; Pascarella & Terenzini, 2005; Ryan, 2004; Tinto, 1993). Early research on college completion found student and institutional characteristics to be the most influential (Wegner & Sewell, 1970). Subsequent studies have continued to validate these early findings (Adelman, 1999; Astin, 1997; Astin, 2005; Attewell et.al, 2011; Scott et al., 2006; Berger, 2002; Goenner & Snaith, 2004; Horn, 2006; Hosch, 2008; Ryan, 2004; Tinto, 1993). Examples of student characteristics include high school curriculum and grades, test scores, socioeconomic status, race, and gender. Institutional characteristics include such variables as selectivity, control, size of enrollment, and resources, such as endowments and faculty.

Previous research and current prediction models do not fully explain the disparities in graduation rates among institutions. For example, a widely distributed and heavily criticized (Myers & Robe, 2009; Pettinelli, 2011) publication *U.S. News and World Report* solely relies on student and institutional characteristics to predict college graduation rates. The difference between the predicted and actual graduation rates is used to determine a "value added" indicator for institutions and factors into their college rankings model. There is often a large gap, however, between predicted and actual graduation rates that is not understood. This gap illustrates that student and institutional characteristics cannot fully explain variations in college graduation rates between institutions (Astin, 2005; Betsinger, Carey, 2004; 2009; Porter, 2009). Further research on additional factors that influence college completion as well as increased

accuracy of graduation rate prediction models has the potential to help explain declining college completion rates and yield innovative strategies for improving degree attainment nationally.

Definition of Terms

Several key terms are used consistently throughout this manuscript and warranted initial explanation. To provide a foundation for understanding the current study, these key terms are defined and explained below.

- *Accountability* is a systematic method to assure stakeholders that colleges and universities are producing desired results. Accountability includes common elements such as goals, indicators or progress towards meeting those goals, measures, analysis of data, reporting procedures, and consequences or sanctions (Leveille, 2006).
- A *stakeholder* in higher education is any person, group, or organization that can place a claim on an organization's attention, direction, or resources. Stakeholders in higher education include students, institutions, local and state governments and agencies, professional accrediting agencies, employers, and the public (Leveille, 2006). The primary stakeholders of interest in this study are students, institutions, and state policymakers.
- The *revised adjusted cohort* is the denominator used to calculate institutional graduation rates. It is defined by The Integrated Postsecondary Data System (IPEDS) as the initial cohort after revisions are made or allowable exclusions are removed. Revisions occur if an institution discovers that incorrect data were reported in an earlier year. Exclusions are permitted for the following reasons: death or total and permanent disability, service in the armed forces, service with a foreign aid service of the federal government, such as the Peace Corps, or service on official church missions.

- The *graduation rate* is calculated as the total number of completers within 150% of normal time divided by the revised adjusted cohort. It is required for disclosure and/or reporting purposes under the *Student Right-to-Know Act*.
- The term *domain* is used as a classification to describe and distinguish between a state's social, educational, economic, and political characteristics.
- *Performance indicators* are data, usually quantitative in form, that provide a measure of some aspect of an organization's performance against which changes in performance can be assessed or comparisons between organizations can be made (adapted from Leveille, 2006).
- A *land-grant institution* is a college or university that has been designated by its state legislature or Congress to receive the benefits of the Morrill Acts of 1862 and 1890. The original mission of these institutions was to teach agriculture, military tactics, and the mechanic arts as well as classical studies so members of the working class could obtain a liberal, practical education (Association of Public and Land-grant Universities, 2012). One institution per state was designated as a land-grant under the Acts of 1862 and 1890. California is unique because the entire University of California system holds land-grant status. The University of California at Berkeley was the original land-grant college, but the University of California at Davis and the University of California at Riverside later assumed much of the agricultural and extension role. As a result, there is one school for northern California and one for southern California. For the purposes of this study, all three UC campuses are included in the land-grant population. Only institutions designated as 1862 land-grants are included in the sample. A list is provided in Appendix A.

Statement of the Problem

Currently, there is growing concern over the stagnant number of college graduates throughout the country and the resulting impact it has on the national workforce and standing in the global economy (Bowen et al., 2009; Carey & Dillon, 2011; DeAngelo, 2011; Lumina Foundation for Education, 2010; Schneider & Yin, 2011). Research has documented deleterious effects of the negative trend in college completion, both for the individual as well as the nation (Carey & Dillon, 2011; Cutler & Lleras-Muney, 2006; Egerter et al., 2009; Schneider & Yin, 2011). Increased awareness of the negative social and economic outcomes as well as international competition has prompted the development of strategic initiatives aimed at improving postsecondary attainment throughout the United States (Carey, 2004; Lewis, 2010; Lumina Foundation for Education, 2010; Russell, 2011; Schneider & Yin, 2011; Wakelyn, 2009). This increased attention and urgency has fostered a rise in the demand for accountability and transparency among institutions of higher education.

As a result of the growing emphasis on accountability, college graduation rates have evolved into a widespread indicator of institutional performance among higher education institutions, policymakers, and the general public (Astin, 2005; Bowman & Bastedo, 2009). Unfortunately, the increased reliance on graduation rates as performance indicators has been accompanied by a lack of understanding of what college graduation rates reflect and how they can and should be used (Astin, 2005; Leveille, 2006). Despite the limited understanding of graduation rate data, they continue to be used by higher education stakeholders to draw conclusions and make significant decisions (Astin, 2005; Burke & Modarresi, 2000; Bowman & Bastedo, 2009; Cook & Pullaro, 2010; Hearn & Holdsworth, 2002; Kelly & Schneider, 2011;

Leveille, 2006; Zusman, 2005). The widespread reliance on graduation rate data and its resulting impact has provided much of the impetus for increased attention to college completion research.

Much of the existing literature on college completion focuses on the influence of students and the characteristics of the institutions they attend. Both student and institutional characteristics have a significant effect on college completion rates (Adelman, 1999; Astin, 1997; Astin, 2005; Astin & Oseguera, 2005; Attewell et al., 2011; Bowen et al., 2009; DeAngelo et al., 2005; Horn, 2006; Pascarella & Terenzini, 2005; Ryan, 2004; Scott et al., 2006; Tinto, 1993). Because student and institutional characteristics account for nearly two-thirds of the difference in graduation rates (Astin, 2005), higher education researchers and scholars emphasize the importance of interpreting and evaluating college graduation rates in conjunction with significant predictors such as socioeconomic status, high school achievement, test scores, race, institutional sector and control, institutional selectivity, and institutional resources and expenditures (Adelman, 1999; Astin, 1997; Astin, 2005; Astin & Oseguera, 2005; DeAngelo et al., 2011; Scott et al., 2006).

Alexander Astin, a pioneer in research on college retention and graduation, has been a staunch advocate of interpreting single statistics, such as graduation rates, within their larger context. He argues that without disaggregating graduation rate data by student characteristics such as academic preparation, socioeconomic status, and race, judgments can be skewed, policies can be misguided, and achievement of national goals can be jeopardized.

> Under these conditions, raw retention rates may unfairly penalize those institutions that admit less-well-prepared students, and bestow undeserved credit on those that are highly selective in their admissions policies…..Similarly, efforts at the state level to make institutions more “accountable” by comparing their raw retention rates are unguided, at best, and perhaps even detrimental to state interest. The danger of such state policies is that they discourage institutions from enrolling relatively poorly prepared students in

> order to maximize their raw retention scores. In any state that strives to promote the quality of economic and social life for all its citizens, being able to effectively educate the less well-prepared student should be given a high priority, since such students pose the greatest risk of eventually becoming dependent on the state (Astin, 2005, page 15).

Other scholars echo Astin's concerns about misinterpretation and misuse of graduation rate data. A recent report issued by the Southern Regional Education Board (SREB) urges states to "identify and require much-improved statewide measures to assess degree completion and related performance indicators for all public colleges and universities" (SREB, 2010, page 6). Statewide performance measures or indicators, Leveille (2006) argues, can only be useful to members of the legislature, government officials, the public, and other stakeholders when they exhibit certain characteristics: appropriateness, relevance, accuracy, timeliness, completeness, and comprehensiveness. Comprehensive understanding and accurate interpretation of any performance indicator is crucial to developing the most appropriate strategies for improving performance.

Better understanding of graduation rates requires moving beyond what has already been extensively studied and confirmed. External stakeholders, such as state and federal policymakers, play a large role in the business of higher education. Because the founders of the U.S. Constitution left the responsibility of education to state governments, the federal government has much less direct influence. The federal government impacts higher education more subtly through financial incentives or conditional mandates, such as student financial aid programs. To highlight a previously mentioned example, reporting and publishing graduation rates are a condition of institutional participation in the Title IV federal student aid program (Asmussen, 2001). While the federal government does not dictate institutional policy and practice, it can unquestionably drive new and emerging agendas. State governments, on the

other hand, do directly regulate institutional policy and practice, particularly at public institutions.

As a result, increasing attention has been shifted to investigating the effect particular state policies and resources have on higher education institutions within each state (Asmussen, 2011; Bount & Turner, 2007; Chen & St. John, 2011; Hearn & Holdsworth, 2002; McLendon et al., 2009; Roska, 2010; Shin, 2010; Tandberg, 2010; Titus, 2006; Titus, 2009; Volkwein & Tandberg, 2008; Weerts & Ronca, 2006; Zhang, 2009). Relevant studies have largely focused on specific, isolated factors, such as state expenditures on higher education and higher education governance structure. Few, if any, have investigated state characteristics from a broad perspective, which might include variables from social, educational, economic, and political domains. Thus, the relevant literature on state characteristics and graduation rates provides an ideal foundation for further research in this area (Asmussen, 2011; Chen & St. John, 2011; McLendon et al., 2009; Roska, 2010; Zhang, 2009).

Investigating the effect of state factors on graduation rates has the potential to provide expanded understanding of college completion and to aid in the development of innovative strategies aimed at improving graduation rates. To aggressively address the mounting pressure to increase degree attainment among the nation's population, better understanding of performance indicators as well as more accurate prediction models are needed to foster collaboration among the three primary stakeholders – students, institutions, and states. New research must be undertaken and new factors need to be considered to effectively solve a problem that has perpetuated for some time.

Purposes of the Study

There were two purposes for conducting the current study. First, I wanted to explore the relationship between selected state characteristics and graduation rates at land-grant institutions. Based on previous literature, state characteristics from each of the domains – social, educational, economic, and political – were chosen in order to assess the broad influence of the state as a unique stakeholder.

Second, I hoped to create a more accurate and explanatory prediction model by adding state characteristics shown to be significantly correlated with college graduation rates to the traditional models that rely solely on student and institutional characteristics. The overarching purpose was to determine whether an expanded prediction model accounted for a larger proportion of the variance in graduation rates than the traditional prediction models.

Research Questions

The specific research questions addressed by the current study were:

1. Is there a significant correlation between selected state characteristics and graduation rates at land-grant institutions?
2. Will an expanded regression model that contains state, institutional, and student characteristics yield more accurate predicted graduation rates than the traditional models that include only institutional and student characteristics?

Delimitations of the Study

The study sample of higher education institutions was limited to the original land-grant institutions, commonly referred to as state flagship universities. Historically Black colleges and universities (HBCU's) and Hispanic serving institutions were excluded from the sample because they comprise a subset of land-grants that have a unique mission, different mandates and

regulations, and a student body that differs significantly from the initial land-grants. Additionally, Cornell University, the land-grant institution of New York, was omitted because it is not a state-funded institution.

Significance of the Study

Although numerous studies have investigated the effect of student and institutional characteristics on graduation rates, the influence of state characteristics has been researched with much less frequency and intensity. While research on the effect specific state characteristics have on college completion has increased over the last couple of decades, the existing studies tend to focus on a limited number of state variables, often within one domain, such as economics or politics (Asmussen, 2011; Bount & Turner, 2007; Chen & St. John, 2011; Hearn & Holdsworth, 2002; McLendon et al., 2009; Roska, 2010; Shin, 2010; Tandberg, 2010; Titus, 2006; Titus, 2009; Volkwein & Tandberg, 2008; Weerts & Ronca, 2006; Zhang, 2009). This study seeks to advance the understanding of graduation rates and foster improvement of data-use practices in higher education by synthesizing the existing literature to investigate the effects of state characteristics on college completion rates. At this time, no prior research studies have analyzed the interactions between a broad array of state variables to include social, educational, economic, and political factors and their influence on degree attainment.

By building on what is currently known about the influence of student and institutional characteristics, the exploration of another level of influence may strengthen our understanding of college completion, refine the interpretation and use of completion rates, and promote shared accountability among stakeholders. Additionally, a better understanding of the factors that contribute to graduation outcomes might foster a more accurate evaluation of institutions within their given state environment, and in turn, perhaps allow for a more productive use of rewards or

sanctions, increase precision in rankings methodology, and provide insight into how state policies and practices might be modified in ways that promote student success.

Summary of Chapter One

There is growing national concern about flat graduation rates and the impact of this trend on individuals and society (Bowen et al., 2009; Carey & Dillon, 2011; Carnevale, 2011). The increasing need for a more educated workforce has fostered a rise in the demand for accountability among institutions of higher education (Schneider & Yin, 2011). Stakeholders have begun to equate graduation rates with institutional quality and performance, and often use such data to make judgments, create policies, and allocate funding (Astin, 2005; Bowman & Bastedo, 2009; Leveille, 2006). Some higher education scholars have argued that the application of graduation rate data is limited, and interpretation must occur within the context of relevant factors known to be strongly associated with graduation rates, notably student and institutional factors (Astin, 2005; Astin & Oseguera, 2005). However, these same scholars have not suggested broadening this context to include state characteristics.

The purpose of the current study was to analyze the relationship between selected state characteristics and college completion rates at land-grant institutions and use those findings to create a graduation rate prediction model, inclusive of student, institutional, and state characteristics, that is more accurate than traditional prediction models comprised solely of student and institutional characteristics. An increased understanding and more accurate prediction of college graduation rates has the potential to improve data-driven decision making, increase the accuracy of institutional evaluation and ranking, and positively impact achievement of educational goals.

CHAPTER TWO

REVIEW OF LITERATURE

Chapter Two summarizes the relevant literature on college graduation rates. The initial section, *History of Graduation Rates,* outlines the emergence and growth of college graduation rates as a widely accepted and published performance indicator in higher education. The middle sections, *Primary Stakeholder Use of Graduation Rate Data* and *Primary Stakeholder Influence on Graduation Rates,* provide evidence about how graduation rates are used by the primary stakeholders of interest in the current study - students, institutions, and states - and how each of these stakeholders influences graduation rates. The final section, *State Characteristics and College Graduation Rates,* identifies particular state characteristics that have been linked to higher education outcomes. Previous findings from multiple domains – social, educational, economic, and political – are synthesized to create a broad foundation for the current study, which aims to discover how a wide range of state characteristics interact to influence graduation rates at land-grant institutions.

History of College Graduation Rates

Graduation rates are a relatively new quantitative indicator of higher education outcomes. In 1989, U.S. Senator Bill Bradley introduced legislation that would require colleges and universities to report graduation rates of their athletes. A former athlete himself, he was interested in providing potential recruits with information about their chances of earning a degree. Congress broadened the legislation to include reporting graduation rates of all college students. As a result, when the Student Right-to-Know and Campus Security Act was passed in 1990, it provided a mechanism for uniform calculation and dissemination of graduation rates (Asmussen, 2011). To facilitate data collection and assist colleges and universities in meeting

the new mandates, the Department of Education began collecting graduation rates in 1996, and reporting to the Department became a contingency of Title IV federal aid (Astin, 1997, Cook & Pullaro, 2010). This initial impetus morphed into a larger accountability effort that pervades current state and federal policy.

The repercussions of collecting and publicizing these data have gradually had a profound impact on students, institutions, and states. Graduation rates are now relied upon by various stakeholders of higher education to make a multitude of decisions (Astin, 2005; Burke & Modarresi, 2000; Bowman & Bastedo, 2009; Cook & Pullaro, 2010; Hearn & Holdsworth, 2002; Kelly & Schneider, 2011; Leveille, 2006; Zusman, 2005). The same stakeholders that use graduation rate data are often the same stakeholders who exert influence on graduation rates.

Primary Stakeholder Use of Graduation Rate Data

Students and institutions have been the primary stakeholders of interest in higher education research, particularly as it relates to college completion. In fact, traditional graduation rate prediction models used by educational and commercial organizations rely solely on student and institutional characteristics (Astin & Oseguera, 2005; Porter, 1999; Scott et al., 2006). Cragg (2009) argues that multiple stakeholders, most notably students, institutions, and states, collectively influence graduation rates and should all be considered integral components of successful, innovation evaluations and solutions aimed at creating a more educated citizenry. The following section describes how the primary stakeholders of interest in the current study – students, institutions, and states – use college graduation rate data to evaluate, plan, and act. Each values and utilizes graduation rates in unique ways, resulting in a single outcome measure that serves a multitude of purposes. Knowledge of how graduation rate data are used illuminates their flexibility as well as their limitations.

Student Use of Graduation Rate Data

Graduation rates and college rankings have become widely published and are readily available to students and their families. Actual graduation rates are reported on numerous federal, state, and third-party websites, including *College Navigator, College Portrait,* and *Peterson's Guide.* As a result, students and their families are increasingly familiar with college completion metrics, and some use these data to make decisions regarding application to and enrollment at colleges and universities (Bowman & Bastedo, 2008; Griffith & Rask, 2007; Kelly & Schneider, 2011; Meredith, 2004; Myers & Robe, 2009). As Astin (2005) points out, prospective students and their parents are led to believe that individual chances for success are greater at colleges and universities with higher completion rates and are being encouraged to make comparative judgments about institutions based on graduation rates. In support of this assertion, multiple studies have found graduation rates to be highly influential on college choice (Cook & Pullaro, 2010; Kelly & Schneider, 2011).

Further propelling student choice are publications such *U.S. News and World Report* and *Princeton Review* that aim to assist in the college selection process by projecting college rankings, which are largely influenced by institutional graduation rates. In the *U.S. News and World Report* ranking methodology, significantly more weight is placed on graduation rates than any other variable in the prediction model. Graduation rate performance, accounting for 7.5% of the model, is defined as the difference between a school's actual graduation rate and the one predicted by *U.S. News.* Another category included in the rankings model is graduation and freshman retention, which accounts for 20% of the equation. Of that 20%, graduation rates account for 80% and freshman retention 20%. Together, these two categories - graduation rate performance and graduation and freshman retention - comprise 27.5% of the rankings model

(Morse & Flanigan, 2011). Table 2 outlines the complete *U.S. News* rankings methodology applicable to national universities, the category which includes land-grant institutions.

Table 2
U.S. News and World Report College Rankings Methodology

Ranking Category	**National University Weight**	**Indicator(s)**	**Percent of Overall Ranking Category Weight**
Undergraduate Academic Reputation	22.5%	Peer assessment survey	66.7%
		Counselors' ratings	33.3%
Retention	20%	Six-year graduation rate	80%
		Freshman retention rate	20%
Faculty resources	20%	Faculty compensation	35%
		Percent faculty with terminal degree in their field	15%
		Percent faculty that is full-time	5%
		Student/faculty ratio	5%
		Class size, % fewer than 20 students	30%
		Class size, % with 50+ students	10%
Student selectivity	15%	Reading and Math scores on SAT and ACT composite score	50%
		Percent of entering students in the top 10% of their high school class	40%
		Acceptance rate	10%
Financial resources	10%	Average spending per student on instruction, research, student services, and related educational expenditures	100%
Graduation rate performance	7.5%	The difference between the predicted and actual graduation rates; a "value-added" measure	100%
Alumni giving rate	5%	Average percentage of living alumni who donated money	100%

Though results have been mixed, prior research findings have shown certain profiles of students to be influenced by college rankings more than others. Griffith and Rask (2007) found that over time, ranking has become more important to high-achievers and students who depend

on financial aid. Other researchers have concluded that the rankings affect college choice among both high-income and minority students (McDonough et al., 1998; Meredith, 2004).

Institutional Use of Graduation Rate Data

If students value graduation rates and use them in decision-making, institutions have no choice but to also focus on the numbers. Institutions are cognizant of the reality that graduation rates impact public perception, revenue, and third-party evaluations, all of which drive institutional outcomes (Bailey, 2006; Hossler, 2000). Research findings indicate that college rankings, which depend largely on graduation rates, were found to predict subsequent financial indicators, including federal research and development funding, alumni donations, and out-of-state tuition and fees (Bowman & Bastedo, 2009). College rankings have also been found to influence subsequent admissions indicators, including the number and quality of applicants, acceptance rates, and yield, the ratio of students who choose to attend to the number who were admitted (Bowman & Bastedo, 2009; Griffith & Rask, 2007; Ehrenberg, 2003; Myers & Robe, 2009). It should be noted that *U.S. News & World Report* rankings appear to have a larger impact on admission outcomes at public universities (Meredith, 2004).

Because college completion rates are among the most accessible and influential indicators of institutional performance, they continue to be tracked, analyzed, scrutinized, and debated. Pressure to improve graduation rates is driven by stage legislatures, regional accreditation bodies, and college ranking systems (Bastedo & Bowman, 2011; Bok, 2006; DeAngelo et.al, 2011). Institutions have largely been held accountable for unimpressive graduation rates and react to this pressure in various ways.

In an effort to report better graduation rates or obtain a higher ranking, postsecondary institutions have responded to the push for higher graduation rates in such ways as changing

admission standards and policies, manipulating data, decreasing academic standards, and focusing expenditures on research and faculty salaries (Astin, 2005; Bastedo & Bowman, 2011; Bok, 2006; Bowman & Bastedo, 2009; Dill & Soo, 2005; Ehrenberg, 2003; Hossler, 2000; Myers & Robe, 2009). For example, several institutions have recently made admission tests, such as SAT and ACT, an optional requirement for applicants (Ehrenberg, 2003). Because of the specific measures in *U.S. News and World Report*, making admission tests optional will likely raise an institution's ranking. Students with high scores are more likely to report them and students with low scores will now be more likely to apply, resulting in an increase in average test scores of entering freshman and a decrease in the number of applicants admitted, both of which are influential measures in the rankings (Enrenberg, 2003).

Another unfortunate example of how external pressure can result in undesirable behavior lies in the debate and subsequent lawsuit over Clemson University's institutional research practices. At the 2009 annual Association of Institutional Research (AIR) forum, Catherine Watts, former director of institutional research at Clemson, gave a presentation in which she discussed the ways in which Clemson had manipulated data to improve their standing in *US News and World Report* college rankings Such manipulation included lowering class size in areas that affect the rankings while increasing class size where it would not affect their standing, giving low scores to peer institutions on the reputational survey, and artificially boosting faculty salary data (Lederman, 2009). Although an extreme case, this example illustrates how the increased demand for accountability and transparency can have counterproductive effects on institutional behavior.

State Use of Graduation Rate Data

State policymakers often use college graduation rates, along with other metrics, to inform funding decisions and to develop or assess policies (Bok, 2006; Reyna, 2010). According to Burke's research (2002), graduation rates are the most used indicator for performance reporting, budgeting, and funding. Performance reporting seeks to use the power of information to advocate for change. Performance budgeting allows policymakers to consider institutional achievements on certain indicators when allocating resources. And performance funding goes a step farther by tying institutional performance on chosen measures to financial incentives. All of these mechanisms are examples of how institutional data can influence resource allocation (Burke & Modarresi, 2000; Hearn & Holdsworth, 2002; Zusman, 2005).

Performance-based funding is not new. The approach was tried and later abandoned by many states (Burke & Modarresi, 2000; Shin, 2010). Now, due largely to the rising demand for accountability and the national achievement goals, it appears to be receiving renewed attention (Lumina Foundation for Education, 2010; Harnisch, 2011). Currently, the Lumina Foundation for Education, the Bill and Melinda Gates Foundation, The College Board, the National Conference of State Legislatures (NCSL), the National Governors Association (NGA), the Southern Regional Education Board (SREB) and the Education Commission of the States (ECS) are all promoting performance-based funding as components of college completion agendas (Harnisch, 2011; SREB, 2010).

While performance-based funding has its merits, critics argue that it focuses on a limited portrait of institutional performance, contributes to mission distortion and decreased access, promotes efficiency over quality, and leads to increased inequality and funding instability among institutions (Harnisch, 2011; Zumeta, 2001). Existing research yields little evidence to support

the funding strategy. A recent study by Shin (2010) found that neither performance-based budgeting nor performance-based funding had an impact on college graduation rates within a state. Asmussen (2011) corroborated Shin's findings and concluded that completion metrics have remained unaltered, despite state adoption of some form of performance-based accountability. Possible reasons for these findings might be that the percentage of higher education funding tied to performance is relatively low compared to the overall budget, and the fact that some states which have articulated performance-based funding policies may not actually allocate or re-allocate resources according to the policy (Hauptman, 2001; Shin, 2010).

In some states, graduation rates also drive state agendas, policies, and practices, with an end result that is often counterproductive to the achievement of statewide educational improvement. According to a recent study by the *Pell Institute,* state policies related to admissions, financial aid, and institutional mission, in particular, may actually complicate efforts to improve retention at larger public universities. States than ban or restrict remediation at four-year institutions directly alter an institution's admission policies. As pointed out by Engle and O'Brien (2007), decreasing state support leaves larger percentages of students with unmet financial need. Furthermore, state policies that are driven by rankings often encourage universities to duplicate missions and vie for the most-academically prepared students in the state. Increased focus on student outcomes in general and graduation rates in particular has also prompted such initiatives as mandated post-tenure review, faculty load mandates that require more time to be spent on teaching, and more stringent workload reporting requirements (Colbeck, 2002). Additionally, some states have used graduation rates to trigger state- and institutional level program review (Hearn & Holdsworth, 2002).

Primary Stakeholder Influence on Graduation Rates

Prior research demonstrates that students, institutions, and states have an effect on resulting graduation rates. The following sections outline the multitude of ways scholars and researchers have found these stakeholders to exert influence on college completion metrics.

Student Influence on Graduation Rates

Attributes and characteristics that students bring to campus, termed input variables, naturally influence the course and outcome of their education. In fact, according to Astin & Oseguera (2005), about two-thirds of the variance in graduation rates between institutions can be attributed to entering student characteristics. Among the most widely studied student characteristics are test scores, high school performance, race/ethnicity, gender, and socioeconomic status. The combination of these factors constitutes the most commonly used variables in traditional college graduation prediction models and together they account for the bulk of variation that can be predicted by student factors (Asmussen, 2011; Astin, 1997; Astin, 2005; Astin & Oseguera, 2005; DeAngelo at.al, 2011; Goenner & Snaith, 2004; Horn, 2006; Hosch, 2008; Ryan, 2004). The following sections explore each student factor individually to provide detailed explanation and possible conclusions.

With little exception, entrance test scores and high school grades are the strongest predictors of college completion (Adelman, 1999; Asmussen, 2011; Astin & Oseguera, 2005; Bowen et al., 2009; DeAngelo et al., 2011; Hosch, 2008; Titus, 2006). Students who score in the top SAT interval (SAT composite of 1300 or greater) are about twice as likely to graduate college than those who score in the bottom interval (SAT composite of less than 800). A similar relationship exists for high school grades. Students who enter college with “A” grade averages are nearly two times more likely to graduate than the students with “B” grade averages and three

to four times more likely to finish college than students with "C" grade averages or less (Astin & Oseguera, 2005). Bowen et al. (2009) reported similar results for entrance exam scores and high school GPA, but, after controlling for test scores, found high school grades to have an even greater effect on the probability of graduating college than test scores alone. Though high school achievement and entrance exam scores have been found to be most predictive of a student's likelihood of completing a bachelor's degree, prior research has found these factors to be associated with other fixed student characteristics, such as race, ethnicity, gender, and socioeconomic status (Astin & Oseguera, 2005; Bowen et al., 2009; DeAngelo et al., 2011; Horn, 2006; Mortenson, 2010, Titus, 2006).

Multiple studies have identified the large gap in graduation rates between high- and low-income students, racial and ethnic groups, and males and females (Astin & Oseguera, 2005; Attewell et al., 2011; Bowen et al., 2009; Carey, 2004; DeAngelo et al., 2011; Horn, 2006; Hosch, 2008; Mortenson, 2010; Tinto, 1993; Titus, 2006). Students in the top distributions of family income are nearly five times more likely to complete a bachelor's degree than those in the bottom quartiles (Bowen et al., 2009). Asians and Whites graduate in the highest numbers while graduation among African-Americans and Hispanics remains much lower (Bowen et al., 2009; U.S. Census Bureau, 2012). Research using The National Student Clearinghouse (NSC) indicates that Asians and Whites are about twice as likely to finish college than both African-Americans and Hispanics (DeAngelo et al., 2011) Trend data provides evidence that the "opportunity gap" has widened and worsened by both income and race in recent years (Bowen et al., 2009; Mortenson, 2010; U.S. Census Bureau, 2012). Females of all races are significantly more likely to complete a bachelor's degree than their male counterparts (Attewell et al., 2011; Bowen et al., 2009; DeAngelo, 2011; Horn; 2006).

Other student characteristics that have been shown to be related to college graduation include age and first-generation status (Bowen et al., 2009; Scott et al., 2006; DeAngelo et al., 2011; Pascarella & Terenzini, 2005; Tinto, 1993). The finding that age has been found to be negatively associated with graduation rates is likely due to the fact that older students experience more risk factors for attrition, such as family and work obligations (Goenner & Snaith, 2004; Scott et al., 2006). First-generation college students face similar challenges as older students and are significantly less likely to finish college than students who have parents with higher education experience (DeAngelo, et. al, 2011). Research points to first-generation students being disadvantaged in such ways as limited basic knowledge about higher education, lower levels of family income and support, poorer academic preparation, unclear college degree plans and expectations, more work obligations during college, slower credit hour accumulation, and less engagement in the college experience (Pascarella et.al, 2004). Though some institutions fare better than others in graduating first-generation students, fostering student success for this demographic appears to pose a persistent challenge across institutional types (DeAngelo et al., 2011).

The impact of student characteristics can vary widely by institutional type and selectivity, which explains why institutional characteristics are commonly controlled for in college completion analyses (Astin, 2005; Astin & Oseguera, 2005; DeAngelo et al., 2011; Horn; 2006). The influence of student characteristics makes it essential to evaluate graduation rates within the context of such characteristics and to develop strategies to mitigate the barriers faced by at-risk students.

Institutional Influence on Graduation Rates

Characteristics of individual colleges and universities help explain the variance in graduation rates between institutions that enroll similar students. For example, selectivity, control, and level of an institution have been found to have the largest institutional impact on college completion rates (Astin, 2005; Scott et al., 2006; Bowen et al., 2009; Horn; 2006; Pascarella & Terenzini, 2005). Other influential factors include faculty employment status, student residential and attendance patterns, tuition and expenditures, and institutional size (Astin & Oseguera, 2005; Bowen et al., 2009; Goenner & Snaith, 2004; Hosch, 2008; Pascarella & Terenzini, 2005; Ryan, 2004; Scott et al., 2006). Because much is known about how these variables affect higher education outcomes, they are also frequently controlled for in college completion analyses.

Selectivity has been shown to be the single largest institutional influence on graduation rates (Astin, 2005; Astin & Oseguera, 2005; Horn, 2006; Titus, 2003; Titus, 2006). Astin (2005) contends that selectivity is such a significant factor because it is largely a reflection of institutional resources and the academic preparation of the student body, and reveals the collinearity between student and institutional characteristics. Selectivity is closely tied to and dependent upon control and level of an institution. Private institutions are generally more selective than public institutions, and four-year institutions are more selective than two-year institutions (Horn, 2006). In short, the highly-selective colleges tend to have the most financial and academic resources and often matriculate a higher proportion of students who meet the most selective admission criteria and who are more likely to succeed (Astin, 2005; Attewell et al., 2010; Bowen et al., 2009).

Institutional faculty statistics also contribute to overall college completion rates. Goenner & Snaith (2004) found student/faculty ratios and the percent of faculty who are full-time to have a significant, positive effect on college graduation rates. A possible explanation for these findings may be that higher student to faculty ratios and higher percentages of full-time faculty may be characteristic of institutions that have greater resources or higher perceived quality, resulting in additional academic support for students and increased incentives for students to graduate (Goenner & Snaith, 2004).

Student attendance patterns (full-time or part-time) and living arrangements have consistently been found to be predictive of institutional graduation rates. Specifically, the percent of students living on campus as well as the distribution of full-time to part-time students make a difference in college completion. The more full-time, residential students an institution enrolls, the higher their graduation rate tends to be (Astin & Oseguera, 2005; Bowen et al., 2009; Hosch, 2008; Pascarella & Terenzini, 2005; Ryan, 2004; Scott et al., 2006). Moreover, the advantages are not limited to just the residential and full-time students; all students appear to benefit from attending an institution where more students live on campus (Bowen et al., 2009). However, Hosch (2008) cautions against interpreting these results too narrowly and argues that higher proportions of full-time students and students living on campus may also reflect the selectivity and resources of an institution, and consequently, the type of students who choose to enroll there.

As data collection has expanded and reporting accuracy has improved, researchers have begun to identify financial indicators, particularly revenue and expenditures, that have an important role in college completion outcomes. Goenner & Snaith (2004) reported a positive relationship between tuition revenue and graduation rates. Similarly, Titus (2006) found college

completion to be positively related to the percentage of revenue derived from tuition and suggests a possible explanation. He argues that as institutions increase their reliance on tuition, they also increase their focus on retaining students.

Previous studies have also noted an association between expenditures and graduation rates, though results remain mixed on where to increase resources in order to obtain optimal outcomes (Goenner & Snaith, 2004; Hosch, 2008; Ryan, 2004; Scott et al., 2006). Goenner & Snaith (2004) studied general expenditures and found that higher expenditures resulted in higher graduation rates. Ryan (2004) specifically investigated instructional and academic support expenditures and found both to be significantly, positively associated with cohort graduation rates. Instructional expenditures were found to be most influential and his findings indicated that a 1% increase in instructional expenditures resulted in more than a quarter percent increase in cohort graduation rates (Ryan, 2004). In a similar study, Scott et al. (2006) concluded that an institutional increase of $1000 in instructional expenditures per student was associated with a near 2% gain in graduation rates among public colleges. Hosch (2008) reported similar results, but after controlling for institutional type by Carnegie classification, the relationship between expenditures and graduation rates disappeared, indicating that financial resources may not influence all types of institutions in the same way. Similar to explanations provided in previous sections, both Hosch (2008) and Goenner & Snaith (2004) suggest that the positive relationships may merely indicate that selective institutions with greater financial resources graduate a higher percent of entering students.

Though findings have been mixed, size of an institution also appears to play a role in graduation rates. Both Astin (1993) and Pascarella and Terenzini (2005) reported institutional size to be inversely related to bachelor's degree attainment. Conversely, Ryan (2004) found size

to have a positive effect on college completion. Scott et al. (2006) also found size to have a significant impact, though the effect size was very small.

Research findings presented in the previous section illustrates how institutional characteristics influence college graduation rates. In summary, the overall graduation rate of a particular institution tells very little about institutional performance unless consideration is given to the characteristics of the institution as well as the students it admits.

State Influence on Graduation Rates

Student and institutional characteristics do not fully explain graduation rates. Despite similar campus features and entering student profiles, national universities are quite varied in their graduation rates, despite similar campus features and entering student profiles. In fact, over one-quarter of institutions have predicted graduation rates ten percentage points higher or lower than their actual graduation rates (Astin & Oseguera, 2005; Porter, 1999). This disparity between predicted and actual graduation rates points to the need to examine additional factors that may influence students and institutions in order to better understand the complexities of degree attainment.

State Characteristics and College Graduation Rates

A state's social, educational, economic, and political characteristics may influence the demand for higher education, the goals and objectives of policymakers, agenda, and the interdependence of stakeholders. As pointed out by Hearn & Holdsworth (2002), "the relationships among the various actors are distinctive to each state and are sometimes unpredictable. They are shaped over time by factors such as the state's economy, political climate, and social and cultural characteristics." Composition of the population as well as other state demographic information, economic resources, educational challenges, and the politics and

governance of a state can impact student readiness and demand, institutional capacity, and state resources for higher education. The following sections summarize the relevant literature regarding the impact of social, educational, economic, and political characteristics on college graduation rates.

Social Characteristics

A state's demographic and population statistics may influence undergraduate education outcomes, including completions (Hearn & Holdsworth, 2002; Weerts & Ronca, 2006). The size of a state's college-age cohort has been shown to significantly impact college completion rates across the state (Bound & Turner, 2007; Bound et. al, 2010). Results of a recent national study conducted by Bound and Turner (2007) found that a 10% increase in the college-age population within a given state leads to a 4% reduction in the percent of the cohort earning a bachelor's degree. After numerous follow-up analyses, Bound and Turner concluded that this "crowding out" effect occurs because states lack the financial resources to support the increased demand for higher education (Bound & Turner, 2007). A 2009 study conducted by Titus corroborated these findings (Titus, 2009).

Other demographics have also been shown to influence college completion. Of the state characteristics investigated by Volkwein & Tandberg (2008), two demographic factors, state size and population growth, accounted for much of the explained variance in higher education performance outcomes, one of which was graduation rates.

Educational Characteristics

A state's educational policies and outcomes undoubtedly affect the number of students who attain a college degree (Carey, 2004). For example, the quality of secondary education has an impact on college graduation rates because it is an indicator of college preparation and

readiness. Prior research has shown that students with strong academic credentials and appropriate college-preparatory courses graduate in larger numbers than students with poor academic preparation (Adelman, 1999; Attewell et al., 2011; Bowen et al., 2009; Carey, 2004). In fact, according to Adelman (1999), the correlation between rigor of high school curriculum and degree attainment is higher than the correlation between degree attainment and both test scores and high school grade point average. Low-income and minority students may be less likely to graduate college if state polices allow under-resourced, under-staffed middle and high schools. States have significant authority to drive secondary school improvement through policies, agendas, and teacher education programs (Callan, 2001).

Additionally, the literature continues to suggest that the lack of alignment between educational sectors may provide a significant explanation for lagging graduation rates (Carey, 2004; Kirst & Valenica, 2001; Kirst et al., 2009) Students receive unclear and contradictory messages from high schools, colleges, and state organizations about how to prepare for college, noting that high school graduation standards often do not match college entrance requirements, state secondary and postsecondary budgets are usually separate, many states do not have adequate data tracking systems, and states are not held accountable for student transition from high school to college (Kirst & Venezia, 2001). Thus, the quality of secondary education and the cohesion of a state's entire education system both play a role in higher education outcomes.

The distribution of enrollments in higher education institutions across a given state also affects graduation rates. The larger the proportion of students attending community colleges in a state, the higher the probability of bachelor's degree attainment at the four-year institutions (Roska, 2010; Titus, 2009). Roska (2010) concludes that this finding is due to the effect of "sorting," whereby students select an institution based on their goals and aspirations, thus

allowing for enrollment of bachelor's degree seeking students at four-year institutions. In states with few community colleges, students are pushed into four-year institutions, regardless of academic preparation or intent to complete a bachelor's degree, and, as a consequence, fail to complete a degree and drive the four-year graduation down.

Multiple studies also indicate a positive relationship between enrollment at private institutions and a state's graduation rate. Specifically, states with a higher percent of total enrollment at private institutions have higher state-wide graduation rates (Titus, 2009; Volkwein & Tandberg, 2008). Researchers suggest this relationship exists because private institutions are often smaller, wealthier, and more selective, allowing them to attract highly-qualified students, offer them more financial aid, and provide a more intimate learning atmosphere (Bowen et al., 2009). Despite higher graduation rates in states with higher private enrollment, researchers caution against statewide college completion strategies that aim to increase private enrollment in order to increase statewide degree attainment. In most states, the private sector is not large enough and the private mission does not support the social mobility that is necessary for closing the graduation gap for minority and low-SES students, one of the leading goals of the national college completion agenda (Bowen et al., 2009).

Economic Characteristics

Given the growing trend of rising tuition and declining state budgets, the effects of funding on higher education is among the most studied aspects of state influence on institutions of higher education (Chen & St. John, 2011; McLendon et al., 2006; Roska, 2009; Ryan, 2004; Scott et.al, 2006; Shin, 2010; Zhang, 2009). The majority of studies find state spending to be statistically significant and positively related to higher education outcomes, though the magnitude of such significance has varied, perhaps due to differences in study populations and

financial indicators. Bound and Turner (2006) argue that public investment in higher education plays a crucial role in determining the degrees produced and the supply of college-educated workers to the labor market. Changes in state resources per student have been found to affect degree attainment (Bound & Turner, 2006; Bastedo, 2010; Titus, 2006; Titus, 2009). In a related study, Zhang (2009), after controlling for institution fixed effects, found only a modest link between state support and academic achievement at public 4-year institutions. Specifically, results indicated a 0.64 percent increase in graduation rates for every 10% increase in state appropriations (Zhang, 2009).

The impact of specific types of state student aid has also been explored by educational researchers. Through multiple studies, Titus, after controlling for student and institutional characteristics, has consistently reported need-based state financial aid to be a strong predictor of college graduation rates (Titus 2006; Titus, 2009). Similar research conducted by Chen and St. John (2011) found that the percent of public tuition covered by state need-based and non-need-based aid has a significant impact on a state's college graduation rates. Results of the study indicate that increasing the ratio of tuition covered by need-based aid resulted in a 2% increase in the graduation rate (Chen & St. John, 2011). Prior studies have also found grant aid, both need-based and non-need-based, to have a positive effect on student persistence and degree attainment; however, their analyses did not separate state grant aid from federal and institutional grant aid, thus making it difficult to discern the impact of state financial aid policies on college completion (Astin, 1993; Bowen et al., 2009; Pascarella & Terenzini, 2005; Tinto, 1993). Furthermore, as Bowen et al. (2009) notes, an important interfering factor in predicting the effect of aid and tuition policies on degree attainment is the cyclical volatility of state appropriations for higher education.

Political Characteristics

The politics and governance of a state influence both higher education spending and general support. State spending on higher education indirectly influences college completion rates; therefore, investigating political characteristics is important in analyzing statewide degree attainment. According to a recent study, the more liberal a state's citizenry, the more supportive of higher education they are (Tandberg, 2010). Tandberg (2010) found that an increase of one unit in the political ideology variable (meaning becoming more liberal) resulted in a .019 increase in higher education effort within the state. Democratic governors as well as Democratic legislatures have allocated more resources to higher education and are more active in educational policy than their Republican counterparts (McLendon et al., 2009; Tandberg, 2010; Volkwein, 1987; Weerts & Ronca, 2006).

Furthermore, legislative professionalism, generally defined as the extent to which state legislatures resemble the U.S. Congress, has a significantly positive effect on state higher education spending (McLendon et al., 2009; Tandberg, 2010). The degree to which the legislative entities are similar is measured by annual legislative salary and number of days in session. Professionalized legislatures tend to be associated with increased spending in general, typically attract more highly-educated members who are more likely to be sympathetic to higher education and place a higher value on it, possess higher analytic ability, and are more likely able to recognize the impact of higher education spending on state goals (Tandberg, 2010). According to a recent national study conducted by Tandberg (2010), a $10,000 increase in legislative salary predicted a .129 increase in higher education effort or spending.

A growing body of literature has examined the impact of state governance of higher education on funding and performance outcomes. According to the Education Commission of

the States (ECS), there are primarily four governance structures with varying degrees of centralized state control over higher education (McGuiness; 2003; Volkwein & Tandberg, 2008). These four structures, in descending order of strength of control, are consolidated governing boards, regulatory coordinating boards, weak coordinating boards, and planning agencies. Consolidated governing boards and regulatory coordinating boards possess direct control over institutional policies, while the weak coordinating boards and planning agencies allow for more institutional autonomy (Volkwein & Tandberg, 2008). Previous findings regarding the impact of governance on funding have been mixed. Weerts and Ronca (2006) reported that centralized governance of research institutions resulted in increased state appropriations Conversely, Tandberg (2010) found centralized governance structures to have a negative impact on funding for higher education. McLendon et al. (2009) found the relationship between governance and funding to be statistically non-significant. It is important to note that the study conducted by Weerts and Ronca (2006) was a case-study of selected research institutions, thereby limiting the generalizability of the findings. Further research is likely to add clarity to the currently mixed results.

The influence of state higher education governance on educational performance measures, including college completion, yields noteworthy findings. Volkwein & Tandberg (2008) analyzed the effect of higher education governance on the following five indicators that comprise the *Measuring Up* state report cards. 1) *Preparation* measures college-readiness, 2) *participation* measures access to higher education opportunities, 3) *affordability* takes family income, college cost, and student financial aid into consideration, 4) *completion* is an indicator of persistence to degree, and 5) *benefits* measure the contribution of college-educated residents to the economic and civic well-being of each state. The researchers concluded that centralized

governance had a negative impact on affordability and benefits and no impact at all on completion, participation, or preparation. However, their findings also indicated that no single model of higher education governance was preferable to another in relation to the performance measures discussed.

Summary of Chapter Two

College graduation rates have only recently become a widely published and relied on measure of institutional performance. The passage of the Student Right-to-Know and Campus Security Act of 1990 mandated reporting of institutional graduation rates to the government and the public (Asmussen, 2011). Federal regulations, coupled with increased concern about declining graduation rates and rising demands for accountability, set the stage for a growing national emphasis on strategies to improve college degree attainment.

Students, institutions, and states use graduation rate data in a variety of ways to make decisions. Students consider graduation rate data when choosing which college to attend (Cook & Pullaro, 2010; Kelly & Schneider, 2011). Research also shows that students and their families use graduation rates to make assessments about the quality of an institution (Astin, 2005). Institutions primarily respond to graduation rates with efforts to improve them. The response has been both positive and negative. While some institutions initiate programs and strategies for improving student success, others have responded to the pressure by changing admission standards and policies, manipulating data, decreasing academic standards, and focusing expenditures on research and faculty salaries in an effort to report better graduation rates or obtain a higher ranking (Astin, 2005; Bastedo & Bowman, 2011; Bowman & Bastedo, 2009; Dill & Soo, 2005; Ehrenberg, 2003; Hossler, 2000; Myers & Robe, 2009). States use graduation rate data to inform funding and policy. Due to the increased demand for accountability and the

federal initiatives to improve college graduation rates, performance-based funding has returned to the forefront of state agendas (Burke & Modarresi, 2000; Harnisch, 2011; Shin, 2010). Graduation rate data have also been used by state policymakers to develop faculty tenure and workload policies and initiate program level reviews (Colbeck, 2002; Hearn & Holdsworth, 2002).

The stakeholders that use graduation rate data, in turn, have an effect on graduation rates. Student and institutional characteristics account for the largest proportion of variance in graduation rates (Astin & Oseguera, 2005). Entering student factors such as high school grades, test scores, socioeconomic status, race, and gender have a cumulatively significant impact on institutional graduation rates (Adelman, 1999; Astin & Oseguera, 2005; Attewell et al., 2011; Bowen et al., 2009; DeAngelo et al., 2011; Horn, 2006; Mortenson, 2010; Titus, 2006). Institutional characteristics such as selectivity, control, level of institution, size of enrollment, faculty demographics, campus residency, tuition, and institutional expenditures have also been reported to have a large effect on graduation rates at the institution (Astin, 1993; Astin, 2005; Bowen et al., 2009; Goenner & Snaith, 2004; Horn, 2006; Pacarella & Terenzini, 2005; Ryan, 2004; Scott et al., 2006). The impact of states on college graduation rates has been largely understudied, though prior research has found that a state's social, educational, economic, and political characteristics may influence the policy environment, agenda, and outcomes as well as stakeholder relationships within higher education (Hearn & Holdsworth, 2002).

State social, educational, economic, and political characteristics are important considerations in college completion research. Each of these domains has been found to have at least some influence on graduation rates. Previous research as well as current national college completion initiatives, many with a focus on what states can do to achieve higher degree

attainment, provide the foundation for the current study which emphasizes the importance of examining the state from a broad perspective (Asmussen, 2011; Chen & St. John, 2011; McLendon et al., 2009; Roska, 2010; Russell, 2010; Zhang, 2009).

CHAPTER THREE

METHODOLOGY

Chapter Three describes the research methods and statistical analyses employed in the current study. The rationale for selection of the research design and the study sample begins the chapter and is supported by the conceptual framework that was used to guide the current study. The dependent and independent variables and the data sources for each are discussed in detail and summarized in Tables 3.1 and 3.2. The statistical tests chosen and the specific steps in the analysis conclude the chapter.

Selection of Research Design

The research design chosen for the current study was a cross-sectional ecologic approach, which involves examining the relationship between selected measures among different groups or populations. A distinguishing feature of ecologic design is that the unit of analysis is the group and individual level data are unknown (Friis & Sellers, 2004). In ecological research, the main effects are likely to be interactions among the characteristics of various levels of influence. (Bronfenbrenner, 1979). Social-ecological designs have long been used in psychology, sociology, child and human development, early education, and epidemiology due to the emphasis of the framework on human behavior; however, this design is rarely employed in higher education, especially in the study of college outcomes. This design is particularly suitable for studying college graduation within a complex set of social structures and interactions.

The dependent variable was the six-year graduation rate of the 2005 entering freshman cohort at land-grant institutions. Control variables were student and institutional characteristics that have previously been shown to have an influence on college graduation rates. And the

independent variables were selected based on relevant literature and reflect multiple domains to include demographic, social, educational, political, and economic factors.

Study Sample

Land-grant institutions of higher education, as established by the Morrill Land-Grant Act of 1862, were selected for inclusion in the current study due to their similarity in history, mission, control, and scope. The selection criterion was established to obtain a homogenous sample so that fewer control variables would need to be addressed and the effect of the independent variables would be more pronounced. Moreover, by examining similar institutions across all fifty states, the geographic variability, or state characteristics, could be isolated. Furthermore, selecting a group of institutions that are highly influenced by state characteristics was critical to answering the research questions. As a result of the design, Cornell University and the University of the District of Columbia were removed from the sample. The 51 institutions included in the current study are listed in Appendix A.

Conceptual Framework Guiding the Current Study

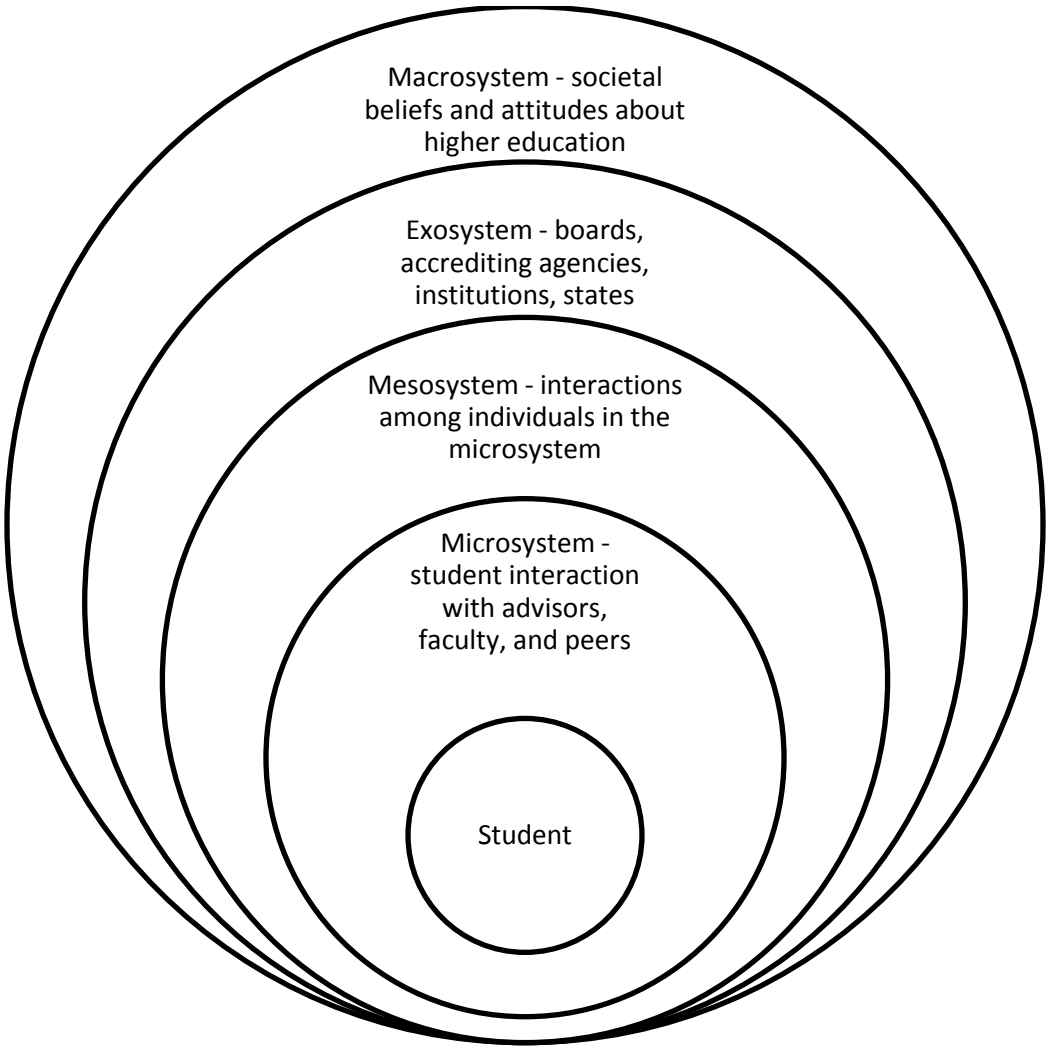
According to Bronfrenbrenner's Ecological Systems theory, human behavior evolves as a function of the interplay between individuals and their environment. He contends that the ecological environment is conceived as a set of nested structures, each inside the next. These four structures include the microsystem, the mesosystem, the exosystem, and the macrosystem. A microsystem is a pattern of activities, roles, and interpersonal relations experienced by the individual in a given setting, such as a home or school. A mesosystem comprises the interactions between two or more environments in which the individual actively participates, such as family, school, or work. An exosystem refers to one or more broader environments that do not involve the individual as an active participant, but in which events occur that affect, or are affected by,

what happens in the environment containing the individual. Examples include local and state organizations as well as state and national government. Generalized patterns of ideology and organization of the social norms common to a particular culture are referred to as macrosystems.

The ecological systems theory relies on the concept of reciprocity – continual interaction within the macrosystem. And, while interactions are reciprocal, one person, group, or system may exert more influence than others. Development of individuals or groups and shifts in influence naturally foster changes within the ecological system. These shifts in roles or settings that occur throughout the lifespan are what Bronfenbrenner terms "ecological transitions" (Bronfenbrenner, 1979).

The ecological systems theory readily lends itself to the study of higher education since colleges and universities are comprised of a hierarchy of stakeholders and interactions. As the theory applies to the current study, the student and his or her immediate environment make up the microsystem, the direct interactions between the student and advisors, faculty, and peer groups comprise the mesosystem, boards of trustees, accrediting agencies, institutional policymakers, and state governments constitute the exosystem, and the overarching societal beliefs and attitudes about higher education define the macrosystem. Figure 1 provides an illustration of this conceptual framework, and is included in the appendices.

Figure 1. Ecological systems framework applied to higher education



Data Sources

A multitude of national, population-based surveys were used to create the dataset for the current study. Government data sources included the U.S. Census Bureau (CB), the American Community Survey (ACS), the U.S. Bureau of Labor Statistics (BLS), the U.S. Bureau of Economic Analysis (BEA), the Department of Education, the National Center for Education Statistics (NCES), and the Education Commission of the States (ECS). Data were also obtained from national associations, university research centers, and standardized higher education institutional reports. These included the National Association of State Student Grant and Aid Programs (NASSGAP), the National Annenberg Election Survey (NAES), and the Common Data Set (CDS). Because each of these data sources provide annual statistics, a true cross-sectional approach was possible. For any graduation cohort entrance year, comparative data that captures the current state condition at the time of matriculation are available.

Variables

The following section describes each variable, identifies the data source, and outlines applicable calculations or transformations. A summary of these variables can be found in Tables 3.1 and 3.2.

Dependent Variable

College graduation rate. The dependent variable of interest was the six-year college graduation rate of the 2005 entering first-time, full-time cohort of students at land-grant institutions. The variable was obtained from the Integrated Postsecondary Education Data System (IPEDS).

Control Variables

Student characteristics. This set of variables consisted of student demographic and pre-college characteristics that have been controlled for in the vast majority of college completion studies. All student variables were aggregated to the institutional level and reflect the 2005 cohort of students at each individual institution. Though age and first-generation status have been shown to influence graduation rates, they were excluded from this analysis. There is very little variation in age among the cohort used to derive graduation rates because IPEDS limits this cohort to first-time, full-time, degree-seeking students. Thus non-traditional students are rarely captured. First-generation status is not reflected in public, unrestricted datasets of aggregate numbers; therefore, it was not possible to include in the current analysis.

Entrance exam score. The 25th percentile score on ACT and SAT exams were included to reflect the academic preparation of entering students. The 25th percentile was chosen over the 75th percentile score because it is preferred in the Carnegie classification of selectivity due to the fact that it describes more students (Carnegie Foundation for the Advancement of Teaching). Because schools report SAT scores, ACT scores, or both, SAT scores were converted to the ACT scale because it has fewer possible scores than the combined SAT and involved less risk of error than converting in the opposite direction. For schools that reported both ACT and SAT scores, a weighted composite score was calculated based on the proportion of students who submitted each type of test score. IPEDS data were used to derive this variable.

High school grade-point average. The average high school GPA for the entering cohort was the value reported by individual institutions in their Common Data Set (CDS) annual report for 2005-2006.

Socioeconomic status. The percent of the entering cohort that received federal grants was used as a proxy in order to provide an indication of the socioeconomic status of the entering students. While this variable does have its limitations, it is the most preferred indicator when student-level income data is not available or not part of the research design (Hosch, 2008). This variable was available through IPEDS.

Race/ethnicity. For the purpose of this study, race/ethnicity reflects the percent of the entering cohort that reported a racial or ethnic category other than White, Non-Hispanic or Asian/Pacific Islander. Though Asians and Pacific Islanders are a population minority, they graduate in similar numbers as White, Non-Hispanics, and therefore were included in the reference group. IPEDS was the data source for this variable.

Gender. The ratio of males to females in the entering cohort comprises the gender variable and was extracted from IPEDS.

Institutional characteristics. Institutional characteristics associated with graduation rates, as outlined in Chapter Two, were included as controls, with the exception of institutional control, level, and distribution of full-time and part-time students. Because the study sample was already homogenous with respect to control and level (all public, doctoral-granting institutions), there was no need to account for differences. Student attendance patterns were removed in order to maintain congruence with the dependent variable, which is limited to the initial cohort of full-time students.

Selectivity. Institutional selectivity was derived from the Carnegie Undergraduate Profile Classification and obtained from IPEDS. The measure is based on the entrance exam scores at a particular institution over a period of time. All of the institutions in the study sample fell into two categories - selective and more selective - and were represented by a dummy variable.

Size. Institutional size was a continuous variable reflecting the total enrollment on the 2005 Fall Enrollment survey of all Title IV institutions in the IPEDS universe.

Instructional expenditures per full-time equivalent (FTE) student. This variable was derived by combining multiple sub-categories of instruction-related expenses. It is the sum of all operating expenses associated with the colleges, schools, departments, and other instructional divisions of the institution and for departmental research and public service that are not separately budgeted divided by FTE. The IPEDS Finance survey for the fiscal year 2005-2006 was the source of these data. Two institutions in the sample, the University of Delaware and Pennsylvania State University, report finances under the Financial Accounting Standards Board (FASB) mechanism while the remaining institutions report according to the Governmental Accounting Standards Board (GASB). There is no crosswalk between the two, thus a conversion is not possible. Consequently, the two FASB values were excluded and the mean of all remaining GASB values was imputed for the two outlying institutions.

Campus residency. The percent of an institution's first-time, full-time, degree-seeking students that lived in college owned, operated, or affiliated housing defines the campus residency indicator. This variable is a component of each institution's Common Data Set (CDS).

Full-time vs. part-time faculty. The percent of total instructional faculty that were full-time (excluding medical school faculty) was obtained from the IPEDS Human Resources survey.

Student-faculty ratio. This variable was defined as the ratio of full-time equivalent (FTE) students per FTE instructional faculty. It is expressed as the number of FTE students per one FTE faculty. Because this measure was added to the IPEDS Fall Enrollment survey in 2008, data for the 2005 cohort was obtained from institutional Common Data Set (CDS) reports.

Table 3.1

Description of Dependent and Control Variables

Variables	Data Source	Description
Dependent		
College graduation	IPEDS	Total number of completers at a given institution within 150% of normal time divided by the revised adjusted cohort
Controls		
Student Characteristics		
Entrance exam score	IPEDS	25% percentile score on ACT/SAT score of entering first-time, full-time cohort
High school GPA	IPEDS	Average high school grade-point average of entering first-time, full-time cohort
Socioeconomic status	IPEDS	Percent of entering first-time, full-time cohort receiving federal grants
Race/ethnicity	IPEDS	Percent of entering first-time, full-time cohort that reported a race/ethnicity other than White Non-Hispanic or Asian/Pacific Islander
Gender	IPEDS	Percent of entering first-time, full-time cohort that was male
Institutional Characteristics		
Selectivity	IPEDS	Categorical variable based on Carnegie classification
Size	IPEDS	Continuous variable representing total 2005 fall enrollment
Instructional Expenditures	IPEDS	Total of all instructional expenditure categories per FTE student
Campus residency	CDS	Percent of the institution's full-time, first-time entering cohort that lived in college owned, operated, or affiliated housing
Full-time vs. part-time faculty	IPEDS	Percent of total instructional faculty that was full-time (excluding medical school faculty)
Student/faculty ratio	CDS	Number of FTE students per one FTE instructional faculty

Independent Variables

State characteristics. The independent variables are made up of state characteristics that prior research has found to be associated with college graduation rates, as outlined in Chapter Two. The variables reflect the social, educational, economic, and political statistics of a given state. For each state variable, where applicable and possible, the data collection year matches the entering year of the graduation rate cohort, 2005.

Racial distribution. This demographic variable represents the percent of the population that was categorized in any racial group other than White, Non-Hispanic and was extracted from the American Community Survey (ACS) that is conducted by the U.S. Census Bureau.

Traditional college-aged population. The percent of a population between the ages of 18 and 24 is typically the "college-going" cohort of a state. This variable was extracted from the American Community Survey (ACS).

Population growth. State population growth is measured by the percent change in total population between 2000 and 2010. This variable was actual population data based on the decennial census conducted by the U.S. Census Bureau.

High school graduation rate. This educational variable was defined as the percent of high school graduates within total state population. These data are collected and published by the Department of Education annually.

Public School Achievement. The percent of a state's public schools meeting adequate yearly progress (AYP) goals was one of the chosen indicators of K-12 school quality. The data represent the academic year 2004-2005, the high school graduation year of the entering 2005 college cohort, and was available through the U.S. Department of Education.

Teacher Quality. The percent of core classes taught by highly-qualified teachers represented the quality of the curriculum for the purpose of this study. It is the second indicator of K-12 school quality at the state level. Highly qualified teachers are those who (1) have a bachelor's degree, (2) have full state certification or licensure, and (3) have demonstrated subject matter competency in the subject they teach. The data represent academic year 2004-2005, the high school graduation year of the entering 2005 college cohort and were obtained from the U.S. Department of Education.

Postsecondary attainment. The percent of the state population over age 25 who have earned a bachelor's degree or higher was used as the indicator for state postsecondary attainment. These data were obtained from the American Community Survey (ACS).

Two-year vs. four-year enrollment. This variable captures the distribution of undergraduate enrollments in two-year and four-year institutions within a given state. Specifically, the percent of two-year enrollments relative to total undergraduate enrollment was used. This information was obtained from the annual IPEDS 12-month enrollment survey.

Private vs. public enrollment. The distribution of private and public undergraduate enrollment within each state was obtained from IPEDS. The variable is expressed as the percent of total undergraduate enrollment that was in the private sector. The only exclusion to this variable was private institutions that do not receive Title IV funding and are therefore not subject to federal reporting.

Higher education governance. State governance of higher education was a categorical variable representing one of four models described by the Education Commission of the States. The four models (from most to least centralized) are consolidated governing board, regulatory coordinating board, weak coordinating board, and planning agency (McGuinness, 2003).

State political ideology. This variable was dichotomous and represented a state's Democratic or Republican partisanship in 2004 based on methodology and results provided by Carsey & Harden (2010). The methodology relies on data from the National Annenberg Election Survey (NAES), the largest academic study of American public opinion conducted during a campaign cycle. Democratic partisanship was coded as 0 and Republican partisanship a 1.

Legislative professionalism. As recommended by McLendon (2009) and Tandberg (2010), annual legislative salary was used to represent legislative professionalism. For states that report a daily rate of pay per calendar or legislative day, the maximum number of session days was used to calculate annual salary. Vermont has no limit on days in session so an estimate (imputation) was created using the mean number of maximum days in session of other states.

Personal wealth. Personal income per capita was used to represent the personal wealth of individuals within a state. Data were extracted from the Bureau of Economic Analysis (BEA).

Gross state product. Gross state product (GSP) is derived from the sum of the Gross Domestic Product (GDP) originating in all the industries in the state and is a comprehensive measure of economic activity (BEA). The GSP per capita was used in the current study in order to account for state size. Data were available from the Bureau of Economic Analysis (BEA).

State need-based grant aid. This variable represented state need-based grant dollars per undergraduate FTE student. Data were available from the National Association of State Student and Grant Aid Programs (NASSGAP).

Higher education appropriations. State appropriations for higher education per full-time equivalent (FTE) student comprised this variable. These data were drawn from the Bureau of Economic Analysis (BEA).

Tuition. Annual tuition for academic year 2005-2006 was obtained for each four-year public institution and then averaged for each state. Data were obtained from IPEDS.

Data Analysis

Multiple statistical tests were employed, including descriptive, correlation, and regression analyses, to address the research questions. All analyses were conducted using SPSS 20.0

Prior to inferential analyses, descriptive statistics were obtained and each variable was plotted in order to detect missing data, determine if outliers were present, and assess the distribution. A scatterplot between each independent variable and the dependent variable was created to assess the relationship. A correlation matrix was then created and evaluated on two levels.

First, the correlation matrix was used to identify the possibility of multicollinearity (Berry & Feldman, 1985). While multicollinearity is a concern that must be addressed, it should be noted that this only becomes problematic when the two variables have an extremely high correlation with each other (Coughlin, 2005). If two independent variables showed a significant correlation of .80 or higher, they were combined, when possible, or the variable that had the weakest correlation to the dependent variable in the initial matrix was removed. An additional diagnostic test, the variance inflation factor (VIF), was conducted to validate suspicions of multicollinearity and a result approaching 10 was used to justify combining variables or removing the one with the least influence (Tandberg, 2010; Volkwein & Tandberg, 2008).

Table 3.2
Description of Independent Variables

Variables	Data Source	Description
Independent		
State Characteristics		
Racial distribution	ACS	Percent of the population that is categorized in any racial group other than White, NH
Traditional college-age population	ACS	Percent of the population between 18 and 24
Population growth	ACS	Percent change in total population from 2000 to 2010
High school graduation rate	NCES	Percent of the population with a high school diploma
Public school achievement	DOE	Percent of public elementary and secondary schools meeting adequate yearly progress (AYP) standards
Teacher quality	DOE	The percent of core classes taught by highly-qualified teachers
Postsecondary attainment	ACS	Percent of a state's population over 25 that has a bachelor's degree or higher
2-year vs. 4-year enrollment	IPEDS	Percent of undergraduate enrollment that was in the two-year sector
Private vs. public enrollment	IPEDS	Percent of undergraduate enrollment that was in the private sector
Higher education governance	ECS	Categorical variable to represent four governance models
State political ideology	NAES	Dummy variable representing Democratic or Republican state partisanship
Legislative professionalism	NCSL	Mean annual legislative salary
Personal wealth	BEA	Personal income per capita
Gross state product (GSP)	BEA	GSP per capita
State need-based grant aid	NASSGAP	State need-based grant dollars per FTE undergraduate student
Higher education appropriations	BEA	Appropriations per capita for higher education
Tuition	IPEDS	Average tuition & fees at four-year public institutions within a state

Second, the correlation matrix was used to determine inclusion of specific independent variables for regression analysis. Independent variables that showed a significant correlation with the dependent variable were retained for further analysis. The correlation analysis was used to address the first research question: Is there a significant association between selected state characteristics and graduation rates at land-grant institutions?

Finally, ordinary least squares (OLS) regression was employed to address the second research question. OLS regression is commonly used in education and the behavioral sciences in order to assess linear relationships. The primary uses of OLS include: testing hypotheses concerning the effects of particular independent variables on a dependent variable, assessing the overall quality of a regression model by how well it explains the variation in the dependent variable, and using the resulting equation to derive predictions of the dependent variable (Coughlin, 2005). The current study employs all of these applications and the use of OLS allowed for better comparison between traditional prediction models that have also utilized OLS and the model being tested.

OLS regression is an appropriate method only when specific statistical assumptions are met (Coughlin, 2005; Pedhazur, 1997). These assumptions include linearity, independence, equality of variance, and normality. First, the relationship between the dependent and independent variables must be linear. Second, independence of the errors associated with the dependent variable must be present. Third, equal variance of the residuals for all predicted values of the dependent variable is assumed. This is referred to as homoscedasticity. Finally, for tests of significance, the errors must be normally distributed (Pedhazur, 1997). For this study, each of these assumptions were assessed and met prior to proceeding with OLS regression.

The coefficients in a regression model can be estimated provided the sample size is greater than the number of parameters to be estimated. When the sample size is smaller, the resulting standard errors will be larger, making it more difficult to reject the null hypothesis and draw inferences on the results (Coughlin, 2005). While it is recognized that the overall sample size is small in comparison to the number of predictors, the analytic technique chosen supports the theoretical framework of the study, which is recommended in statistical textbooks (Coughlin, 2005; Pedhazur, 1997). Further, the data is population-based rather data drawn from a sampling frame and the actual parameters are known, thus eliminating the error of estimates. There is no intent to generalize beyond the population under investigation, in this case, a fixed population of flagship land-grant institutions that will not change over time.

Steps in Ordinary Least Squares Regression

The creation of a best fit regression model requires multiple steps. The initial model served as a foundation for the final best-fit model. The purpose and description of each regression model is outlined in the following section.

Model One

The initial model contained the control variables and served as a reference for interpreting the final model and answering the second research question. This allowed the researcher to determine whether adding state characteristics improved the graduation rate prediction model. Both student and institutional characteristics were placed into block one because all variables were aggregated to the institutional level of analysis. The enter method was used to ensure that the model statistics captured the inclusion of all of the controls.

Model Two

The second model investigated the change in the R^2 when the independent variables were added. Block one was comprised of the control variables, student and institutional characteristics. These were the factors that have consistently been shown to have a significant impact on college graduation rates and are used in nearly all basic college completion prediction models and were not being analyzed for influence. Block two contained all of the state characteristics that were found to have a significant correlation with the dependent variable. A stepwise entry technique was employed and state variables that did not significantly contribute to the model were dropped. The approach resulted in the final best-fit model.

By comparing the proportion of variance accounted for by Model One (student and institutional characteristics) to the proportion of variance explained by Model Two (student, institutional, and significant state characteristics) and contrasting the graduation rates predicted by the current model to those of a traditional model, the remaining research question could be answered - will an expanded regression model that contains state, institutional, and student characteristics yield more accurate predicted graduation rates than the traditional models that include only institutional and student characteristics?

Summary of Chapter Three

The purpose of this cross-sectional ecological study was to determine the influence of selected state characteristics on graduation rates at land-grant institutions and to develop a prediction model that incorporates state characteristics into traditional models relying solely on student and institutional characteristics. Data were taken from population-based annual surveys conducted by the federal government or non-profit associations. Correlation and regression were

used to analyze the relationship between the dependent variable, graduation rates, and selected state characteristics, which included a combination of categorical and continuous variables.

CHAPTER FOUR

RESULTS

Chapter Four provides the results of descriptive, correlation, and regression analyses, accompanied by an explanation of how each analysis was conducted and interpreted. Relevant tables and graphs are also included. The analytical findings provided answers to the research questions, which are discussed in the following chapter.

Descriptive Statistics

Descriptive statistics were calculated and scatterplots were analyzed to assess the distribution of each variable as well as the relationship among variables. Each variable was evaluated for normality and visual examination of histograms and scatterplots confirmed that each variable approximated the normal distribution and that there was a linear relationship between the dependent and independent variables. To identify possible outliers that might impact further analyses, leverage values and *Cook's D* values were calculated and assessed. A leverage value represents the distance between the value of each observation of a particular independent variable and the mean of all the particular independent variable's values. Leverage values should not exceed the number of parameters multiplied by three, then divided by the number of cases (Pedhazur, 1997). In the current study, the upper leverage limit was 0.70, much larger than any of the actual leverage values. Leverage values cannot detect an influential observation whose influence is due to its status on the dependent variable. Thus, *Cook's D* (distance) was needed to identify an influential observation whose influence is due to its status on the independent variable(s), the dependent variable, or both. As a general rule of thumb, a *Cook's D* value of greater than 1.0 indicates an observation that is exerting influence (Pedhazur, 1997). In the current study, each value of *Cook's D* was close to zero, the largest being 0.19. As

a result of evaluating leverage and *Cook's D* values, it was determined that the current sample did not contain any outliers. Descriptive statistics are provided in Table 4.

Correlation Results

A correlation matrix of all variables was assessed to detect issues of multicollinearity and determine which independent variables of interest to include in the regression model. Based on the a priori methodology, three bivariate correlation coefficients exceeded the threshold of .80, thus necessitating further assessment. First, there was a strong association between average high school grade point average and entrance exam scores, $r(37)=.819$, $p < 0.001$, indicating that the two variables were not independent of one another. After further analysis, high school grade point average was found to have a weaker correlation with graduation rates than entrance exam scores, thus high school grade point average was dropped from the analysis. Second, personal wealth and bachelor's degree attainment were found to be strongly correlated, $r(49)=.806$, $p < 0.001$. Each of the variables had a similar correlation with graduation rates, and the addition or omission of each did not affect the final model. Both variables were eventually dropped using the stepwise technique in the regression analysis (Harrell, 2012). Finally, personal wealth and gross state product were strongly correlated, $r(49)=.808$, $p <0.001$. When further examination revealed that gross state product was not significantly associated with graduation rates, it was omitted.

Table 4
Descriptive Statistics of All Study Variables

Variables	*N*	*Mean*	*SD*	*Min*	*Max*
Dependent					
College graduation	51	67.2	12.4	31	90
Controls					
Entrance exam score	51	22.1	2.1	18	26
High school GPA	39	3.52	0.21	3.10	4.07
Socioeconomic status	51	19.4	8.6	8	49
Race/ethnicity	51	12.6	8.5	2.8	52.5
Gender	51	48.4	4.5	39.6	60.1
Size	51	25,939	11,550	8,228	51,175
Instructional expenditures	51	9,019	2,541	5,174	16,125
Campus residency	51	33.2	12.2	14	72
Full-time vs. part-time faculty	51	82.3	11.9	44.4	99.1
Student/faculty ratio	51	17.0	2.5	11	22
Independent					
Racial distribution	51	21.4	13.2	3.4	75.1
Traditional college-age population	51	9.3	0.8	7.8	12.4
Population growth	51	10.0	7.1	-0.6	35.1
High school graduation rate	51	85.5	3.8	78.5	91.3
Public school achievement	51	74.6	16.2	34	97.7
Teacher quality	51	89.2	11.4	34.3	99.4
Postsecondary attainment	51	26.5	4.5	18.7	36.9
2-year vs. 4-year enrollment	51	37.8	14.7	3.9	69.7
Private vs. public enrollment	51	20.5	10.9	4	50
Legislative professionalism	51	30,348	25,714	0	95,291
Personal wealth	51	34,231	4,670	26,443	48,134
Gross state product (GSP)	51	41,177	7,208	28,046	64,780
State need-based grant aid	51	289	226	5	855
Higher education expenditures	51	6,426	2,004	3,030	13,425
Tuition	51	4,857	1,572	2,274	8,884

Note. Min=Minimum. Max=Maximum. SD=Standard Deviation.

A number of independent state-level variables exhibited a significant correlation with the dependent variable, graduation rates. These included traditional college-age population, secondary teacher quality, postsecondary attainment, political ideology, legislative professionalism, personal wealth, higher education appropriations, state need-based grant aid, and tuition. Based on correlation results, these independent variables were selected for inclusion in the regression model being tested. Table 5 outlines the association of these variables with the dependent variable as well as the correlations among control variables and the dependent variable.

As Table 5 illustrates, entrance exams scores, institutional selectivity and size, instructional expenditures, campus residency, state postsecondary attainment, state teacher quality, legislative professionalism, personal wealth, state need-based grant aid, average four-year tuition and fees, and the two- to four-year enrollment distribution exhibited a positive correlation with the dependent variable, indicating that increases in these values corresponded to an increase in graduation rates. The effect size, which indicates the strength of a relationship, is useful in interpreting the practical significance of the relationship. For large sample sizes, a relationship might be statistical significant but have a small effect size and consequently little practical significance (Glass & Hopkins, 1996). According to Cohen et al. (2003), a Pearson's correlation of .10 exhibits a small effect size, 0.30 represents a medium effect size, and 0.50 constitutes a large effect size. Entrance exam scores, institutional selectivity and size, need-based grant-aid, and tuition had a large effect size, while the remaining positive, significant correlations showed a medium effect size.

Table 5

Correlation Matrix of Dependent, Control, and Significant Independent Study Variables

Variables		1	2	3	4	5	6	7	8	9	10	11
1	Graduation rate	1										
2	Entrance exam score	.89**	1									
3	High school GPA	.75**	.82**	1								
4	SES	-.36**	-.46**	-.38*	1							
5	Race/Ethnicity	-.05	-.08	-.02	.23	1						
6	Gender	-.09	-.10	-.10	.23	-.19	1					
7	Selectivity	.71**	.76**	.64**	-.44**	-.01	-.03	1				
8	Size	.64**	.66**	.47**	-.32*	.16	-.02	.58**	1			
9	Instructional expenditures	.34**	.40**	0.35*	-.22	.05	-.17	.24	.41**	1		
10	Campus residency	.40**	.36**	.21	-.18	-.20	.04	.30*	-.08	.05	1	
11	FT vs. PT faculty	.21	.23	.37*	-.21	-.02	-.12	.33*	.22	-.08	-.03	1
12	Student/Faculty ratio	-.12	-.20	-.04	.12	.10	-.12	-.11	-.02	-.37**	-.22	.19
13	College-age population	-.48**	-.36**	-.25	.21	.15	-.02	-.33*	-.21	-.31**	-.45**	.14
14	Teacher quality	.36**	.28*	.07	-.05	-.37**	.20	.22	.32*	-.27	.21	.34*

*p <.05. **p < .01

Table 5, Continued

Correlation Matrix of Dependent, Control, and Significant Independent Study Variables

Variables		1	2	3	4	5	6	7	8	9	10	11
15	Postsecondary attainment	.34*	.32*	.20	-.06	-.03	-.17	.23	.04	.23	.53**	-.05
16	2-yr vs. 4-yr enrollment	.38**	.24	.45**	.06	.38**	-.08	.10	.28*	.23	-.17	.24
17	Political ideology	-.33**	-.27	-.19	.06	-.09	.20	-.23	-.25	-.32*	-.19	.20
18	Legislative professionalism	.44**	.37**	.19	.07	.20	-.08	.30*	.41**	.49**	.13	-.08
19	Personal wealth	.39**	.37**	.18	-.21	.02	-.18	.27	.14	.47**	.47**	-.16
20	Higher education appropriations	-.28*	-.14	-.13	-.03	.28*	-.15	-.15	-.15	.33**	-.09	-.10
21	State need-based grant aid	.52**	.43**	.32*	-.03	.08	.28	.37**	.42**	.36*	.30**	-.16
22	Tuition	.50**	.39**	.19	-.16	-.22	.16	.43**	.20	.17	.67**	-.07

*p <.05. **p < .01

Table 5, Continued

Correlation Matrix of Dependent, Control, and Significant Independent Study Variables

Variables		12	13	14	15	16	17	18	19	20	21	22
12	Student/Faculty ratio	1										
13	College-age population	.13	1									
14	Teacher quality	.15	-.21	1								
15	Postsecondary attainment	-.20	-.31*	-.06	1							
16	2-yr vs. 4-yr enrollment	-.02	.04	.11	.13	1						
17	Political ideology	.08	.52**	-.03	-.19	-.15	1					
18	Legislative professionalism	-.27	-.20	-.16	.29*	.34*	-.46**	1				
19	Personal wealth	-.23	-.44**	-.13	.81**	.21	-.29*	.41**	1			
20	Higher education appropriations	-.28	.09	-.39**	.03	.20	-.01	.10	.34*	1		
21	State need-based grant aid	-.30**	-.39**	.18	.28*	.27	-.43**	.48**	.32*	-.16	1	
22	Tuition	-.38**	-.52**	.24	.40**	-.14	-.32*	.34*	.32*	-.31*	.55**	1

*p <.05. **p < .01

Socioeconomic status of the entering cohort, traditional college-age proportion of the population, state political ideology, and state higher education appropriations were negatively correlated with the dependent variable, indicating that decreases in those values corresponded to increases in graduation rates. The correlation between graduation rates and state college-age population had a strong effect size, while all other negatively associated variables displayed a medium effect size. State political ideology was a dummy variable, with 0 representing Democratic partisanship and 1 representing Republican partisanship. Thus, the negative correlation means that Democratic states were associated with higher graduation rates.

OLS Regression Results

There were four primary assumptions of ordinary least squares regression that had to be met before proceeding with the statistical analysis. These included linearity, independence, homoscedasticity, and normality (Glass & Hopkins, 1996). Linearity between the dependent variable and each independent variable was assessed by plotting the dependent with each independent. Visual examination of the plots indicated a linear relationship. Further, the plot of the residuals versus predicted values confirmed that points were symmetrically distributed around the horizontal line and there was no evidence of a "bowed" pattern (Pedhazur, 2007). If a "bowed" pattern had been present, it would have indicated non-linearity of the variables.

Independence of the errors was assessed by computing the residual autocorrelations. The *Durbin-Watson* statistic provides a test for significant residual autocorrelations. Ideally it should be close to 2 and acceptably between the range of 1.4 and 2.6 (Pedhazur, 2007). The *Durbin-Watson* was 2.197, signifying that the residuals were independent.

Next, homoscedasticity was addressed. Homoscedasticity refers to equal variance of the residuals for all predicted values of the dependent variable. To confirm homoscedasticity, a plot

of the residual values versus the predicted values was evaluated to ensure the absence of residuals getting larger. If heteroscedasticity had been present, the plots would have displayed a fan or bowtie pattern (Coughlin, 2005; Pedhazur, 2007).

Finally, the assumption of normality was assessed by creating plots of the residuals and visually examining the distribution (Coughlin, 2005; Pedhazur, 2007). Data points should fall close to the diagonal regression line and not resemble a bow or S shape. Each plot approximated the normal distribution curve. After addressing each of these assumptions and determining that ordinary least squares regression was appropriate for the data and research questions, the regression analysis was initiated.

As outlined in Chapter Three, the first step in the regression analysis was to create a model that included only control variables. This initial model served as a reference for the second model because it determined how much of the variance in graduation rates was attributable to student and institutional characteristics. The second model included the selected state characteristics in a second block and employed the stepwise entry method to determine the independent variables that added significant predictive value to the initial model. Each model is further explained in the following sections.

Model One

The first regression model was intended to represent the proportion of the variance explained by student and institutional characteristics commonly found in traditional prediction models and served as the starting point for comparison to the final best-fit model. Entrance exam scores, socioeconomic status, race/ethnicity, gender, selectivity, size, instructional expenditures, campus residency, full-time vs. part-time faculty ratio, and student/faculty ratio were combined into block one and treated as controls using the enter method. The entry method

forces each of the variables into the model, regardless of the contribution of each variable to the overall model (Glass & Hopkins, 1996). Model One explained 82.0% of the variance in graduation rates, though only the unstandardized coefficient for entrance exam scores was significant (Table 6).

Model Two

The second model included the control variables in block one and the independent variables previously identified as significant in block two. The best fit model was obtained by employing the stepwise entry method. In this method, each variable is entered in sequence and its value assessed. If adding the variable contributes to the model, it is retained, but all other variables in the model are then re-tested to determine whether they are still contributing to the model. If they no longer contribute significantly they are removed. Thus, this method ensures that you end up with the smallest possible set of predictor variables in the final model (Glass & Hopkins, 2006; Pedhazur, 2007). The final model included three state characteristics – two- to four-year undergraduate enrollment distribution, state appropriations per FTE student, and traditional college-age population. Model two accounted for an additional 9.3% of the variance in graduation rates of the land-grant institutions in this study. The regression summary of model one and model two is provided in Table 6.

The part correlation is a measure of the correlation between the dependent variable and an independent variable when the linear effects of the other independent variables in the model have been removed from the independent variable and is related to the change in R^2 when a variable is added to an equation (Glass & Hopkins, 1996). In the final model, part correlations revealed that entrance exam scores and the two- to four-year enrollment distribution explained

the largest proportion of variance in graduation rates, 6.7% and 5.7%, respectively, after controlling for all other independent variables,.

As an additional test for multicollinearity, the variance inflation factor (VIF), was calculated for each variable of the final model. A VIF of more than 5 and a tolerance of less than 0.2 indicates that multicollinearity is present (Tandberg, 2010; Volkwein & Tandberg, 2008). The VIF range for the final model was between 1.3 to 4.3 with no tolerance values less than 0.2, thus multicollinearity was not an issue in the current study.

Table 6
Orindary Least Squares Regression Model Summary

Model 1	*b (s.e)*	R^2	ΔR^2
Entrance Exam	4.260 (.794)**		
SES	.124 (.120)		
Race/ethnicity	-.027 (.111)		
Gender	-.105 (.210)		
Selectivity	1.783 (2.772)		
Size	.000 (.000)	.820	
Instructional expenditures	.000 (.000)		
Campus residency	.166 (.085)		
FT vs. PT faculty	-.010 (.079)		
Student/Faculty ratio	.282 (.382)		
Model 2			
Entrance Exam	3.245 (.612)**		
SES	.019 (.090)		
Race/ethnicity	-.064 (.092)		
Gender	-.162 (.153)		
Selectivity	2.804 (2.077)		
Size	.000 (.000)	.912	.093
Instructional expenditures	.001 (.000)		
Campus residency	.144 (.068)*		
FT vs. PT faculty	-.052 (.061)		
Student/Faculty ratio	.041 (.285)		
2yr vs. 4yr. enrollment	.254 (.052)**		
Higher education appropriations	-.001 (.000)*		
Traditional college-age	-2.243 (.936)*		

*p<.05, **p<.01

Summary of Chapter Four

Chapter Four outlined the results of descriptive, correlation, and regression analyses. According to correlation statistics, the following state characteristics exhibited a significant correlation with graduation rates: size of the traditional college-age population, secondary teacher quality, postsecondary attainment, ratio of two- to four-year enrollment, political ideology, legislative professionalism, personal wealth, higher education appropriations, state need-based grant aid, and average public four-year tuition. Addition of those state variables to a regression model containing student and institutional characteristics yielded three significant state predictors – size of the traditional college-age population, higher education appropriations, and the ratio of two- to four-year enrollment. The final model accounted for an additional 9.3% of the variation and predicted more accurate graduation rates of the study institutions.

CHAPTER FIVE

FINDINGS, DISCUSSION, AND RECOMMENDATIONS

The final chapter provides an overview of the study and discusses the study findings and conclusions. Implications of the findings for higher education and recommendations for improved practice are provided. The chapter concludes with recommendations for future research and a discussion of the limitations of the current study design and results.

Overview of the Study

The purposes of the study were 1) to identify state characteristics that are significantly correlated with graduation rates at land-grant institutions and 2) to determine whether an expanded prediction model that included state, institution, and student characteristics would explain a larger proportion of variance in graduation rates than a model containing only institutional and student characteristics. State, institutional, and student characteristics were collected from population-based surveys available through government and national association sources. Results of the statistical analyses outlined in Chapter Four provided the basis for study conclusions and discussion.

Findings

Each of the study purposes was accompanied by a specific research question as outlined below. The results of the descriptive, correlation, and regression analyses provided answers to these questions.

Research Question #1

Is there a significant correlation between selected state characteristics and graduation rates at land-grant institutions?

Correlation results identified a significant association between graduation rates and a number of state characteristics that were included in the regression model. Independent state-level variables that exhibited a significant correlation with the dependent variable, graduation rates, included traditional college-age population, secondary teacher quality, postsecondary attainment, ratio of two- to four-year enrollment, political ideology, legislative professionalism, personal wealth, higher education appropriations, state need-based grant aid, and average tuition.

Postsecondary attainment, secondary teacher quality, legislative professionalism, personal wealth, state need-based grant aid, average four-year tuition and fees, and the two- to four-year enrollment distribution exhibited a positive correlation, meaning that increases in these values corresponded to an increase in graduation rates. Conversely, traditional college-age population, political ideology, and higher education appropriations were negatively correlated, indicating that decreases in those values corresponded to increases in graduation rates. Traditional college-age population had a large effect size, while the effect size of political ideology and higher education appropriations was moderate. As previously stated, political ideology was a dummy variable, with 0 representing Democratic partisanship and 1 representing Republican partisanship. The negative correlation indicated that Democratic states were associated with higher graduation rates.

Research Question #2

Will an expanded regression model that contains state, institutional, and student characteristics yield a more accurate predicted graduation rate than the traditional models that include only institutional and student characteristics?

The addition of state characteristics did improve the predictive power of the model. The control model, consisting of student and institutional characteristics, accounted for 82% of the

variance in graduation rates while the expanded model which included the controls plus three significant state variables – the two- to four-year enrollment distribution, higher education appropriations, and traditional college-age population – explained 91.2% of the variance. These variables warrant additional discussion about how and why they influence graduation rates at flagship land-grant institutions.

Discussion and Conclusions

The inclusion of three state characteristics increased the predictive accuracy of graduation rates at land-grant institutions. The distribution of higher education enrollments at two-year and four-year institutions within a state, higher education appropriations, and the size of the college-age population helped explain why graduation rates can be significantly different at institutions with similar characteristics and students. Each of these findings is discussed in the following section and plausible conclusions are explored.

The distribution of higher education enrollments throughout the state exerted a rather large influence on resulting graduation rates. Specifically, for every 4% increase in the proportion of two-year enrollments, graduation rates at land-grant institutions increased about 1%. The results are consistent with previous findings showing that the larger the proportion of students attending community colleges, the higher the probability of bachelor's degree attainment at all four-year institutions within the state (Roska, 2010; Titus, 2009). Roska (2010) attributes this finding to "sorting," a mechanism that essentially matches individual student aspirations with the most appropriate educational sector. He also pointed out that in states with very few community colleges, bachelor's degree attainment was lower, arguably because students who did not intend to complete a bachelor's degree were not afforded the opportunity to seek technical or associate's degree level training (Roska, 2010).

While this finding could signify educational efficiency within a state, subsequent investigation revealed significant correlations between size of the two-year sector and the size of the state minority population, the ratio of private to public undergraduate enrollments, and high school graduation rate. The first relationship was positive while the latter two were negative. This suggests that the distribution of two- to four-year enrollments within a state may likely be affected by race, affluence, and academic achievement. These findings support the argument that four-year graduation rates are higher in states that have a larger community college sector because the four-year institutions, particularly the flagships, continue to enroll only those students most likely to succeed, while at-risk students are funneled through the community colleges and indirectly denied access to bachelor's degree attainment (Bowen et. al, 2009; Roska, 2010).

The current study also identified higher education appropriations as a significant predictor of graduation rates at flagship land-grant institutions. However, the direction of the influence was unexpected. Earlier studies found graduation rates to be positively associated with higher education funding, though the magnitude of the relationship has been quite variable, perhaps due to differences in study populations and financial indicators (Bound & Turner, 2006; Bastedo, 2010; Titus, 2006; Titus, 2009). While current data indicated a negative relationship, examining the relationship within the context of the previously discussed finding regarding two- to four-year enrollments yields a plausible explanation. Because current study findings indicated that higher graduation rates correspond with higher community college enrollment, it might explain why higher graduation rates are associated with lower state appropriations. It is cheaper to provide education at two-year institutions and state funding of community colleges is often supplemented by local appropriations (Auguste et.al, 2010; Snyder & Dillow, 2012). This

finding may also reflect declining public financial support for major public research universities, such as the University of California at Berkeley and the Pennsylvania State University. Weerts & Ronca (2006) have termed these institutions "quasi-private" and point out that they are increasingly been forced to rely on rising tuition and private support to maintain quality. As a consequence, these "high-achieving" institutions may reside in states with relatively low higher education support, but are not negatively affected due to their diminishing financial reliance on state resources. Both explanations provide meaning to this study's findings that higher average tuition and lower state appropriations are correlated with higher graduation rates.

Lastly, results of regression analyses indicated that the size of a state's college-age population has an impact on graduation rates, a finding that is supported by previous research (Bound & Turner, 2007; Bound et. al, 2010). In 2007, Bound and Turner found that a 10% increase in the percent of 18-24 year olds within a state corresponded to a 4% reduction in graduation rates. This study's results show that for every 1% increase in the college-age cohort, graduation rates at land-grant institutions decreased 2.2%. While Bound and Turner's findings exhibit similar direction and magnitude as results of the current study, the two are not directly comparable. The former studied longitudinal data within states and this study examined cross-sectional between-state effects. The current study supports prior conclusions that a "crowding out" effect occurs when the college-age cohort increases because states lack or fail to provide the financial resources to support the increased demand for higher education (Bound & Turner, 2007; Titus, 2009). Current findings illustrate a significant negative association between the size of the college-age population and resource-related variables including institutional selectivity, instructional expenditures per FTE student, percent of undergraduate students living

on campus, personal wealth, state need-based grant aid per FTE student, and average four-year tuition within a state.

Recommendations for Improved Practice

The increase in predictive accuracy of the current model underscores the importance of evaluating college graduation rates within a larger context, including state-level metrics in planning, and fostering improved collaboration among stakeholders to aid in the achievement of college completion goals. Increasing the accuracy of prediction models is not just a theoretical concern; better models have practical implications for students, researchers, ranking organizations, institutional and state policymakers, and others. As discussed below, a better understanding of the ecological nature of higher education and the impact that various levels of factors have on college outcomes can result in improved interpretation, evaluation, prediction, and planning.

Improved Interpretation and Evaluation of Graduation Rates

The results of the current study provide end users of graduation rate data, notably students and policymakers, with a better understanding of the factors that influence graduation rates. The current overarching emphasis on graduation rates would be better shifted to an emphasis on a broader array of outcome measures as well as increased recognition of the multitude of input and process measures that contribute to college completion outcomes. Due to the limitations of how graduation rates are calculated, additional outcome measures should be emphasized and publicized. Examples of additional outcome measures include degrees and certificates awarded, transfer rates, and time and credits to degree (Hoffman & Reindl, 2011; Reyna, 2010). Bok (2006) argues for student learning as an essential performance indicator and outcome measure, though he addresses the difficulty associated with measuring student learning.

However, he argues that such efforts should be undertaken and contends that continued reliance on more measurable outcomes is unlikely to improve undergraduate education (Bok, 2006).

Similar to prior studies that advocate for graduation rates disaggregated by race, gender, and socioeconomic status (Astin, 2005; Astin & Oseguera, 2005; Bowen et.al, 2009; DeAngelo et al., 2011; Reyna, 2010; Scott et al., 2006), the current findings suggest that in order to gain a better understanding of why some states have higher graduation rates than others, it would be beneficial to disaggregate national attainment rates by state characteristics such as enrollment distribution, appropriations, and population demographics. For example, the results of this study suggest that lower four-year graduation rates should be expected in states with limited community college opportunities or a high proportion of the population that is traditional college-age just as prior research has noted that lower graduation rates are more common at institutions with a high at-risk student population.

Improved Prediction of Graduation Rates

Given the current findings, higher education researchers and ranking organizations can use relevant state characteristics to improve the accuracy of graduation rate prediction models, specifically those applied to land-grant institutions. For example, a more accurate prediction model could have a noticeable impact on college rankings. *U.S. News and World Report*, one of the most popular rankings organizations, predicts college graduation rates using student and institutional characteristics. As discussed in Chapter Two, the difference between the predicted graduation rate and the actual graduation rate comprises 7.5% of the final ranking of an institution. The accuracy of predicted graduation rates has a real impact on the students, institutions, policymakers, and other stakeholders that use college rankings to make decisions. Table 7 illustrates the comparison between the *U.S. News* predicted graduation rate, the actual

graduation rate, and the current model predicted graduation rate for 2011. Nearly 16% of values predicted by *US News and World Report* are 10 or more percentage points away from the actual graduation rate, while only one of the current model predicted values fall in that range. In fact, the majority of graduation rates predicted by the current model fall within 5% of the actual rate, indicating increased accuracy of the current model in predicting graduation rates at land-grant institutions.

A more accurate predicted graduation rate could produce a more accurate college ranking, making college rankings a more useful consumer tool. While graduation rate performance comprises only a fraction of the overall ranking model, each improved measure can potentially have a positive impact on college rankings and as a result, institutional policies and practices. The University of Alaska is a good example of the improved predictive capacity of the current model. The *U.S. News* predicted graduation rate for the University of Alaska is 49% while the actual graduation rate is 31%, a difference of 18 percentage points. The current model predicted a graduation rate of 32%, resulting in a mere one percent difference. As shown, predicted institutional performance can be vastly improved by including state demographics, resources, and policies.

Table 7

US News vs. Current Model Predicted Graduation Rates, in Percents

Institution	*US News* Predicted	Actual Graduation Rate	Current Model Predicted
Auburn University	65	66	62
University of Alaska	49	31	32
University of Arizona	64	61	63
University of Arkansas	66	59	66
University of California, Berkeley	90	90	90
University of California, Davis	80	82	77
University of California, Riverside	69	67	63
Colorado State University	60	64	72
University of Connecticut	70	83	79
University of Delaware	73	78	76
University of Florida	85	84	82
University of Georgia	77	82	78
University of Hawaii	61	55	55
University of Idaho	56	51	51
University of Illinois, Urbana-Champaign	78	82	88
Purdue University	66	68	65
Iowa State University	62	68	64
Kansas State University	62	56	59
University of Kentucky	66	59	64
Louisiana State University	65	60	62
University of Maine	57	60	59
University of Maryland, College Park	82	82	87
University of Massachusetts, Amherst	62	67	70
Michigan State University	63	77	74
University of Minnesota	68	70	74
Mississippi State University	56	60	57
University of Missouri	66	69	71
Montana State University	55	51	54
University of Nebraska	65	67	65
University of Nevada, Reno	56	51	50
University of New Hampshire	62	76	73
Rutgers, The State University of New Jersey	69	77	81
New Mexico State University	37	46	47
North Carolina State University	70	72	76
North Dakota State University	56	54	54
The Ohio State University	69	80	79

Table 7, Continued

Institution	*US News* Predicted	Actual Graduation Rate	Current Model Predicted
Oklahoma State University	63	62	68
Oregon State University	55	61	63
Pennsylvania State University	70	87	77
University of Rhode Island	51	63	64
Clemson University	75	80	77
South Dakota State University	54	60	53
University of Tennessee	67	63	65
Texas A&M University	74	81	77
Utah State University	55	52	51
University of Vermont	65	72	75
Virginia Polytechnic Institute and State University	72	82	78
Washington State University	62	67	67
West Virginia University	55	57	59
University of Wisconsin, Madison	80	82	83
University of Wyoming	56	53	53

Improved Planning for Higher Education

The results of the current study indicate that there are a number of characteristics beyond students and institutions that help explain the variance in graduation rates, and these characteristics should be considered when developing and evaluating institutional, state, and national college completion goals and progress. State and institutional policymakers might benefit from analyzing current and projected higher education enrollment distributions, resource allocations, and population demographics as part of their strategic planning and institutional assessment processes.

One particular college completion strategy that might be improved is the practice of performance-based funding. Achievement of a mutually agreed-upon target graduation rate is

often a significant factor in performance funding formulas. If target graduation rates are more accurately identified by including significant state characteristics, goals can be more realistic, resources can be more fairly awarded, and shared responsibility for institutional outcomes might be further embraced by state policymakers. Without considering state characteristics when planning and allocating resources, institutions might be unfairly penalized, thus reducing the likelihood of achieving statewide education goals. As pointed out by the Southern Regional Education Board, the recognition of the limitations associated with graduation rates calls for the use of new metrics, such as reduced student attrition rates, increased year-to-year persistence rates, and improved rates of developmental course completion to derive performance-based funding allocations (SREB, 2010). Further, Bok (2006) argues that state policymakers might foster the largest gains in educational achievement by offering incentive funding for internal assessment of programs and policies designed to identify weaknesses and experiment with solutions.

Additionally, funding might be more closely matched to population demographics. If a large surge in college demand can be forecasted, additional resources can be allocated to increase the elasticity of colleges and universities. According to a recent report by the Southern Regional Education Board, states will need to make higher education funding a priority and finance the increased enrollment necessary to meet state and national goals (SREB, 2010). If states are unable to meet the educational demands of its citizenry, the achievement of state and national college completion goals is unlikely.

To help meet the increased demand for higher education, the ratio of two- to four-year enrollments must be delicately balanced in order to achieve higher bachelor's degree attainment at the state level. While the current study shows that higher community college enrollments

within a state result in higher college completion rates at four-year institutions, it does not explain the impact of community college transfers on overall postsecondary attainment within a state, due to the fact that transfer students are currently not included in IPEDS graduation rate calculations. Higher enrollment in community colleges may predict higher graduation rates at four-year institutions merely because the cohort on which four-year graduation rates are based excludes transfer and part-time students. Many college completion initiatives call for improvements in two- to four-year transfer policies and emphasize the importance of multiple entry points in reaching higher bachelor's degree attainment rates at the state level (Russell, 2010; Wakelyn, 2009). While community college transfers and successful completions will not improve institutional graduation rates, as long as calculations remain the same, improvements that foster student movement throughout the educational pipeline can certainly result in a citizenry with higher levels of educational achievement.

The final recommendation is for community college leaders, university leaders, and state policymakers to collaborate more effectively in order to create new strategies that promote community college success, transfer to a four-year institution, and completion of a bachelor's degree for more students. As early as 1993, Jones & Ewell pointed out that transfer and articulation policies play a large role in achieving higher statewide bachelor's degree attainment and all players must work together to achieve this goal.

> Policies on the transfer of credit among institutions afford state authorities a rare opportunity to take leadership in academic policy. As students increasingly attend more than one institution to achieve a baccalaureate degree, the undergraduate curriculum becomes a joint product of the state's higher education system rather than the exclusive domain of a single college or university. More and more, this implies that the state act as an advocate for coherence and good practice to ensure that those attending multiple institutions are well served (Jones & Ewell, 1993, page 27).

Recommendations for Future Research

Study results also provide evidence of the necessity for additional research related to the influence of state characteristics on graduation rates. Most importantly, the study should be expanded to include additional groups of higher education institutions. Replicating the current study with a sample of public two-year institutions and four-year institutions that do not hold land-grant status would further illuminate the impact of state characteristics on higher education outcomes, specifically the effect that enrollment distributions and college-age cohort size have on graduation rates at other types of institutions. Different sectors of public higher education might be affected by different combinations of state characteristics. Determining how a multitude of state factors uniquely impacts various groups of institutions would allow strategic completion initiatives to be tailored to each state and institution.

Future research might also benefit from an exploratory analysis of state characteristics that have not previously been studied or linked to higher education outcomes. Only state characteristics that have been reportedly influential on college completion outcomes were included in the current analysis. However, numerous educational, social, economic, and political factors that have yet to be examined in the context of higher education might provide additional findings that foster improvement in understanding and prediction of college graduation rates.

Limitations of the Study

The results of this study must be interpreted in the context of their limitations. Perhaps the most significant limitation is the study sample itself. Because land-grant colleges and universities comprise a unique population within the higher education universe, the results cannot be generalized to other types of institutions. Furthermore, the aggregated state characteristics may have more influence on some land-grants than others. For example, state

higher education appropriations per FTE is a measure that represents all students within the state and may not be accurately reflective of how much money is allocated to the land-grant university, though land-grants typically receive higher than average allocations.

Additionally, the dependent variable, graduation rates, is a limited outcome measure. Because of the method in which college graduation rates are defined and calculated by federal agencies, the college completion outcomes of part-time and transfer students and students who begin in the spring are not factored into reported graduation rates. As college students become increasingly non-traditional, the measure becomes less explanatory of student and institutional success.

Finally, the influence of state characteristics on college graduation rates is limited to the existing literature on the selected variables. State factors that have not yet been studied may help explain additional variance in graduation rates.

Final Summary

The landscape of higher education does appear to be ecological in nature. Student, institutional, and state characteristics comprise a unique mix of input, process, and output measures. Graduation rates are merely one higher education outcome measure that remains very limited in their ability to explain or predict the performance of students, institutions, and states. Consideration of a wide range of student, institutional, and state characteristics, rather than emphasis on a single data point, must become a trend. Multiple metrics could produce a "dashboard" of student success that would be more appropriate, relevant, accurate, timely, complete, and comprehensive. Thus, interpreting, evaluating, predicting, and planning for higher education success requires new, expanded ways of thinking and doing in order to turn state and national educational attainment goals into reality.

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APPENDICES

Appendix A. Land-Grant Institutions Included in the Study Sample

Auburn University
University of Alaska, Fairbanks
University of Arizona
University of Arkansas, Fayetteville
University of California, Berkeley
University of California, Davis
University of California, Riverside
Colorado State University
University of Connecticut
University of Delaware
University of Florida
University of Georgia
University of Hawaii, Manoa
University of Idaho
University of Illinois, Urbana-Champaign
Purdue University
Iowa State University
Kansas State University
University of Kentucky
Louisiana State University
University of Maine
University of Maryland College Park
University of Massachusetts Amherst
Michigan State University
University of Minnesota
Mississippi State University
University of Missouri, Columbia
Montana State University
University of Nebraska, Lincoln
University of Nevada, Reno
University of New Hampshire
Rutgers, The State University of New Jersey
New Mexico State University
North Carolina State University
North Dakota State University
The Ohio State University
Oklahoma State University
Oregon State University
Pennsylvania State University
University of Rhode Island
Clemson University
South Dakota State University
University of Tennessee
Texas A&M University
Utah State University
University of Vermont
Virginia Polytechnic Institute and State University
Virginia State University
Washington State University
West Virginia University
University of Wisconsin, Madison
University of Wyoming

Appendix B. Ecological Theory Framework Guiding the Current Study